MAINLY ABOUT EMPHYSEMA OF THE LUNGS

Volume II

(This Volume Should Be Consulted In Conjunction With Volume I)

ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
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R. T. H. LAENNEC,
Professeur Royal de Médecine au Collége de France. Prof. de Clinique à la Faculté de Médecine de Paris. Chev. de l'Ordre Royal de la Légion d'honneur, &c.

Figure 1. Sketch of Laennec by C.J. Williams showing him as he appeared when making his visits to La Charité in 1825-26 with Laennec's signature. (Taken from 'Memoirs of Life and Work' by Williams, London 1884).

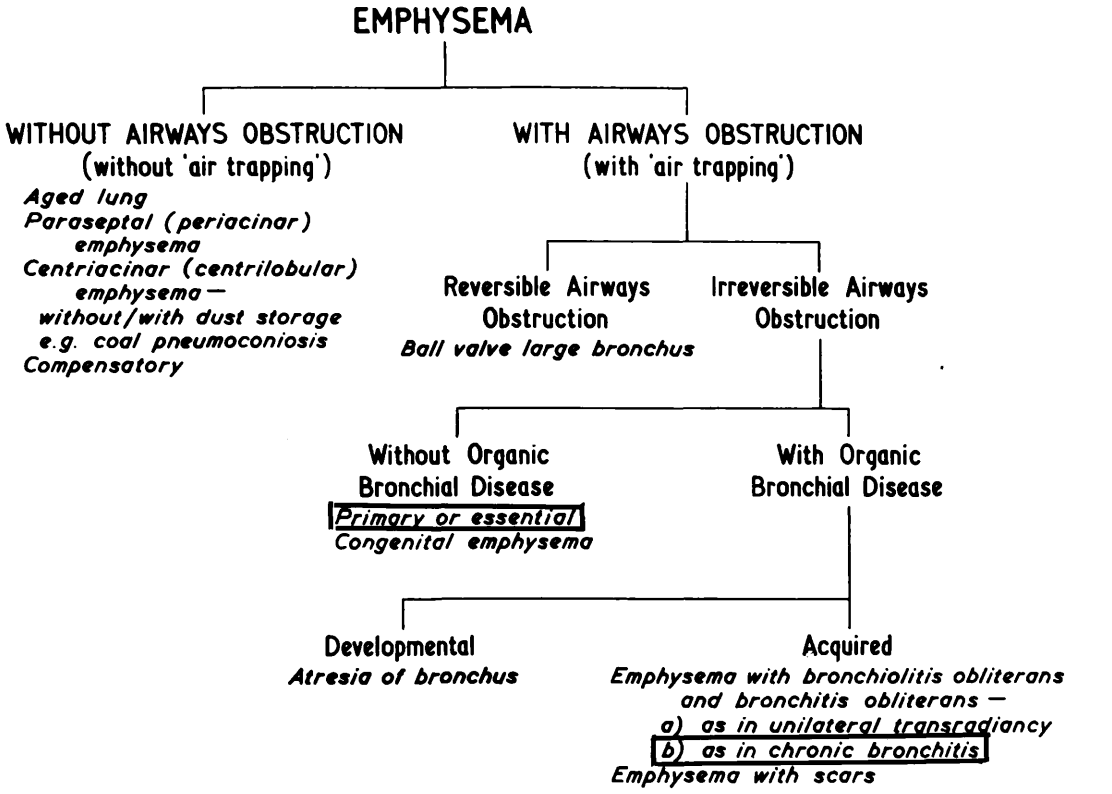

Figure 2. Classification of emphysema by Dr. L.Mc.A. Reid illustrating variety of types presented clinically according to the presence or absence of airways obstruction. The types in boxes are those with which the thesis is mainly concerned. (Reproduced with the authors' permission).

1. Excess of air in the Lungs.

   * Low flat diaphragm
   * Large retrosternal translucent area

2. Cardiovascular changes.

   * Narrow vertical heart
     Prominence of pulmonary trunk
     Large hilar and small lung vessels

3. Bullae.

     Avascular transradiant area
     May be demarcated by a white line
     May have no definite border

Figure 3. Criteria for radiographic diagnosis of emphysema by Dr. George Simon.

* These values can be measured (Reproduced with the author's permission).

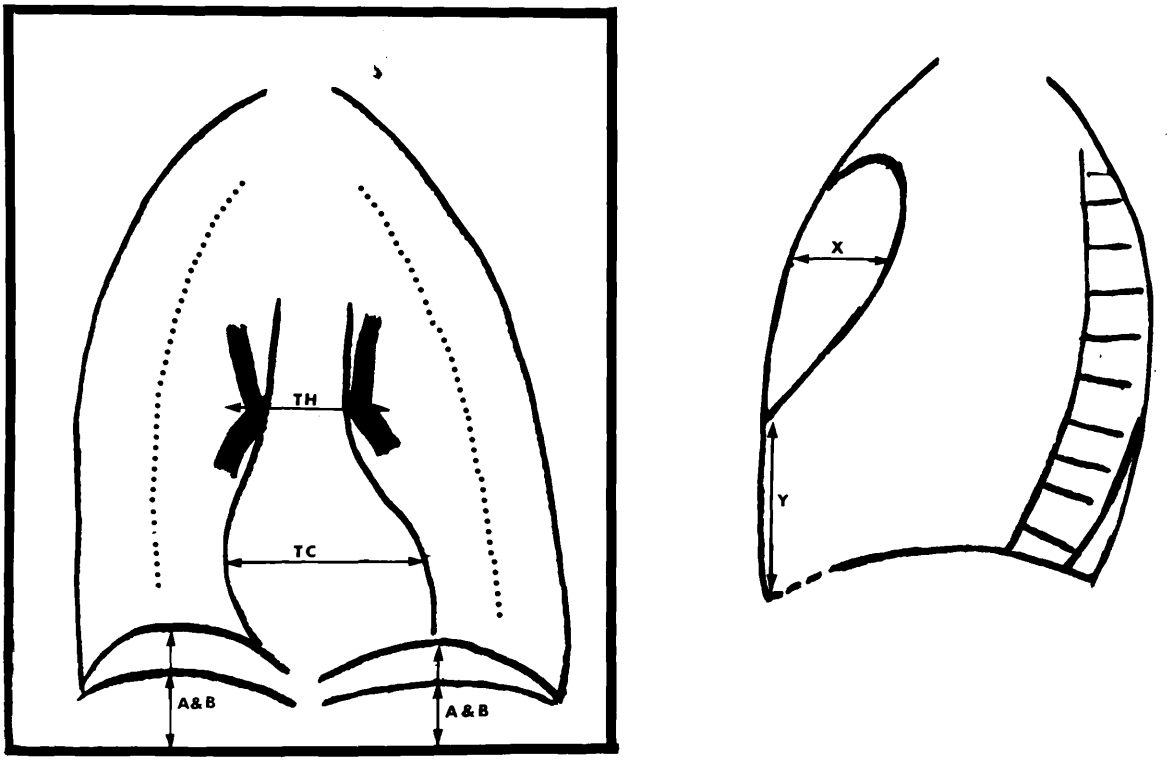

Figure 4. The position of the measurements described in the text on the postero-anterior and lateral chest radiographs are shown.

In the postero-anterior view:-

T.H. - the transhilar diameter measured at the point where the upper lobe vein crosses the lower lobe artery.

T.C. - transverse diameter of the heart.

A-B - the movement of the hemidiaphragms between inspiration and expiration.

The dotted line shows the position where the size of the mid-lung vessels is observed.

In the lateral view:-

X - depth of retrosternal translucent area.

Y - downward extension of retrosternal translucent area.

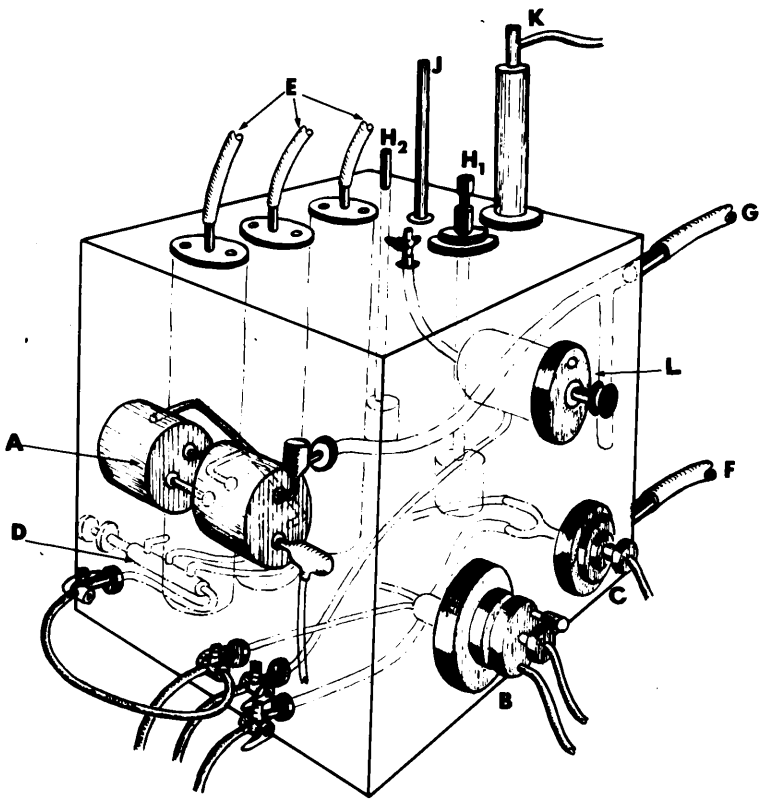

Figure 5. This is a perspective drawing of the electrode water bath. A, B, and C are the pH, oxygen and carbon dioxide electrodes respectively. Heaters H_1 and H_2 are shown, the first being used for rapid boosting of heat initially and the other is used for maintenance purposes. The temperature of the water in the bath is controlled by the contact thermometer regulator K and further checked by readings from the thermometer J. F and G are the entry and exit tubes for the water flow through the bath. Note that water circulations of the pH electrode is in a separate jacket. The tubes E contain distilled water equilibrated with different percentages of gases. They have direct access to the CO_2 and O_2 electrodes through the sleeve valve, D. L is a tonometer which has been used for other projects but is not generally employed.

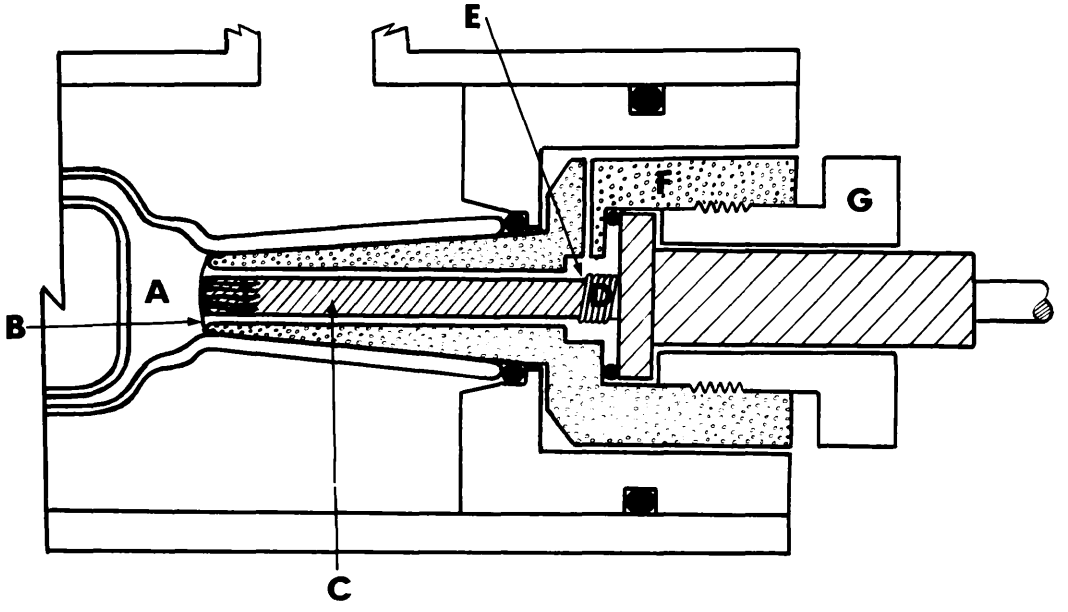

Figure 6. This is a diagram of the multicathode oxygen electrode. The blood sample is contained in the cuvette A and is in contact with the polyvinyladine membrane B. The platinum multicathode C is on the other side of the membrane surrounded by electrolyte solution in the electrolyte chamber E. D is the silver anode, F the electrode housing and G the electrode retaining screw.

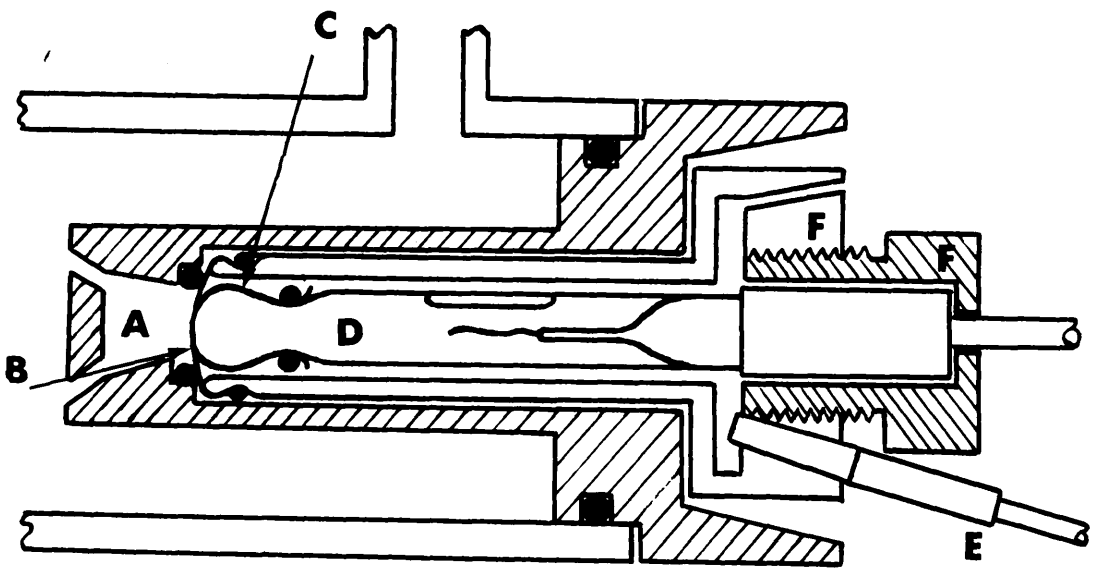

Figure 7. This is a diagram of the carbon dioxide electrode. The blood sample is contained in the cuvette A where it is in contact with the outer Teflon membrane B which is in apposition with the woven fibreglass membrane C. The membranes are kept in place with 'O' rings. D is a glass electrode and E is the calomel reference anode. F is the housing of the whole electrode.

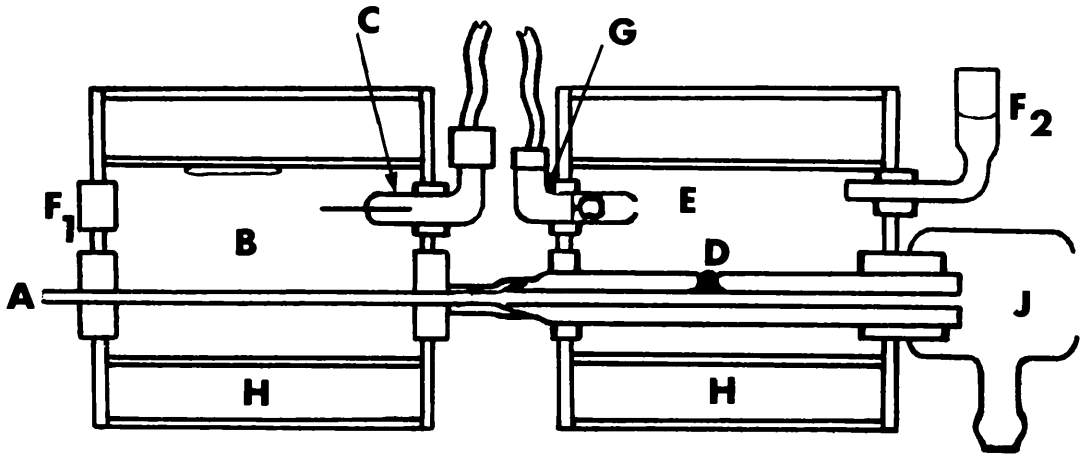

Figure 8. A diagram of the pH replaceable capillary electrode supplied by Electronics Instruments Ltd. The sample is sucked through replaceable tube A into J. A, B and C comprise the glass electrode. B is a chamber containing HCl with a filling point at F, and C is a silver/silver chloride electrode. D is a porous plug separating the sample from E which is filled with Molar KCL filled from the reservoir at F_2. G is a reference electrode and H is the heated circulated water jacket.

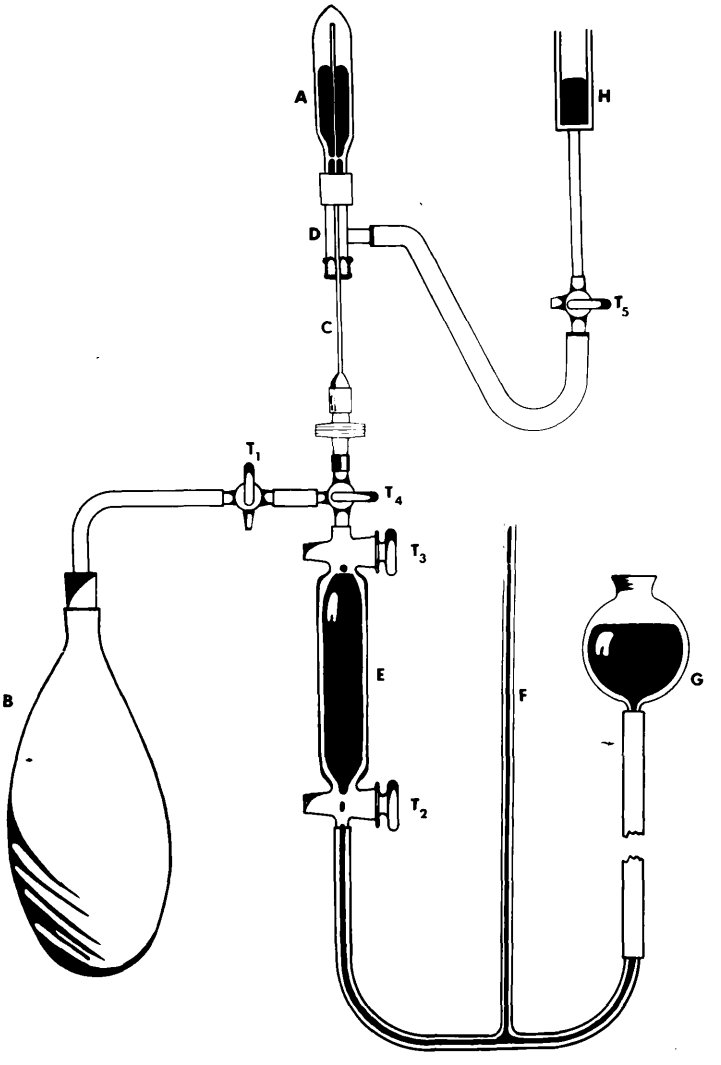

Figure 9. Diagram of the tonometer used for storing ^{133}Xe and the apparatus used during transfer of the radioactive gas from the ampoule A to the tonometer bulb E. To transfer the ^{133}Xe, the bag B containing 100% CO_2 is connected to the tonometer and the dead space of the bulb and T piece, D is flushed with CO_2 leaving the bulb half full of CO_2. Mercury then fillsthe T piece and the seal of the ampoule is broken by tip of the metal cannula C. The radioactive gas is displaced by the mercury into the tonometer diluted by CO_2. Stopcocks T_1, T_2, T_3, T_4 and T_5 are used during this procedure. F is a manometer and G is a mercury reservoir, both of which are required to maintain the stored ^{133}Xe under negative pressure.

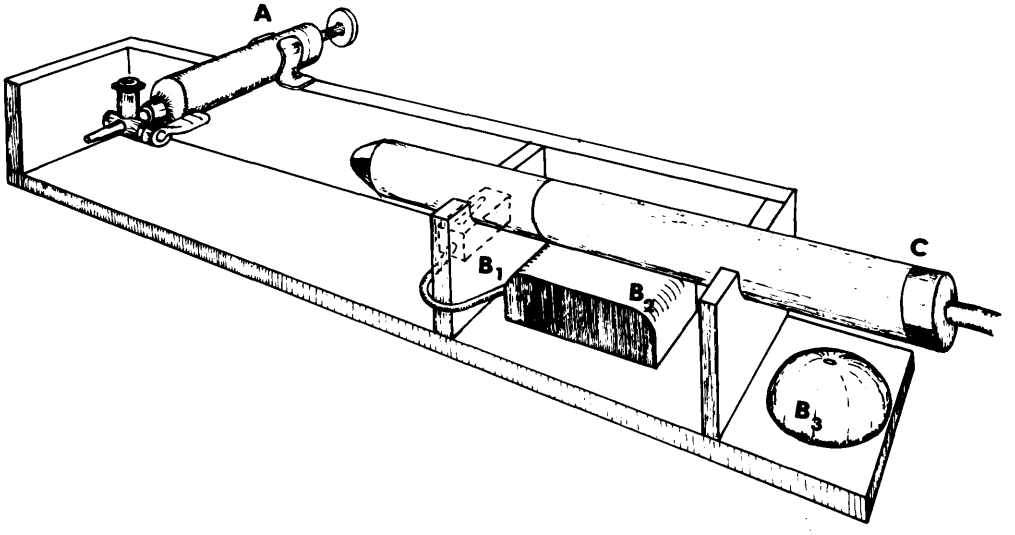

Figure 10. This is a drawing to show the fixed geometric system used for counting the activity in the syringe A of ^{133}Xe in saline before perfusion. The counting head C is one of those from the gantry. B_1, B_2 and B_3 constitute an alarm bell system with microswitch and transformer and bell respectively. These warn the operator if the procedure with the patient is began with a counting head missing from the gantry.

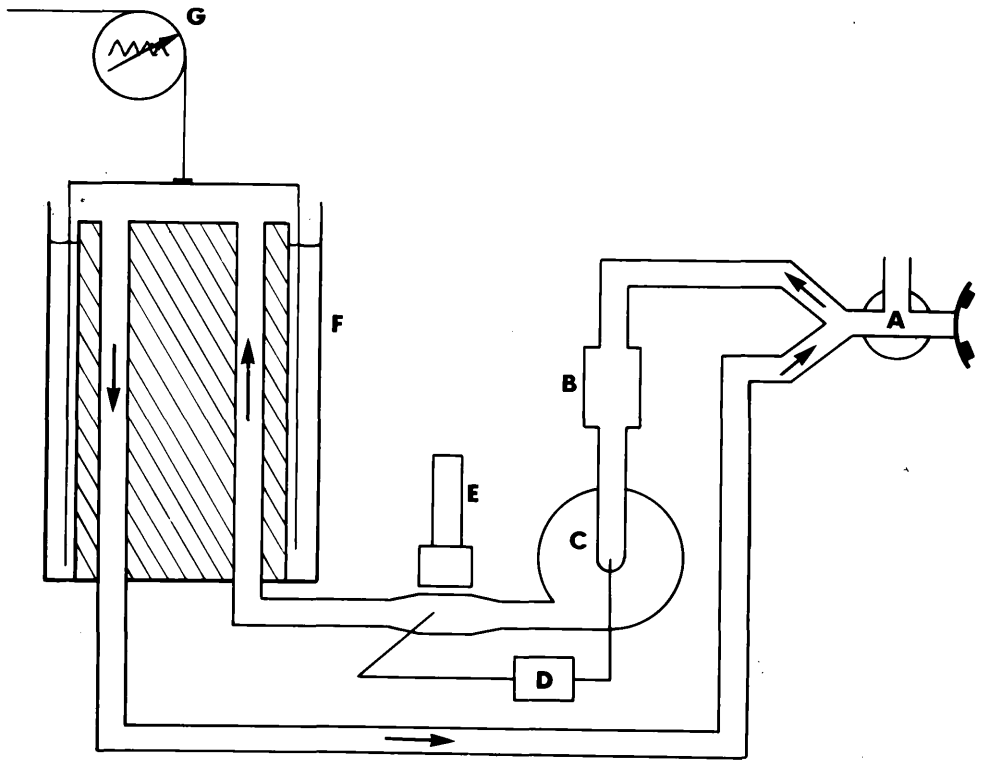

Figure 11. This is a diagram of the closed circuit spirometer system containing the ^{133}Xe in air. The patient breathes through the mouth-piece and 3-way tap A. The gas is circulated by the mixing pump C in the direction of the arrows at 36 litres/min. through a soda lime canister B which absorbs CO_2 during rebreathing. The radioactivity in the circuit is monitored by the counting head E. Inspiration and expiration are shown on the spirometer F and recorded through potentiometer on the spirometer pulley G. Oxygen is introduced at A during the rebreathing procedure sufficient to keep the volume of the circuit constant.

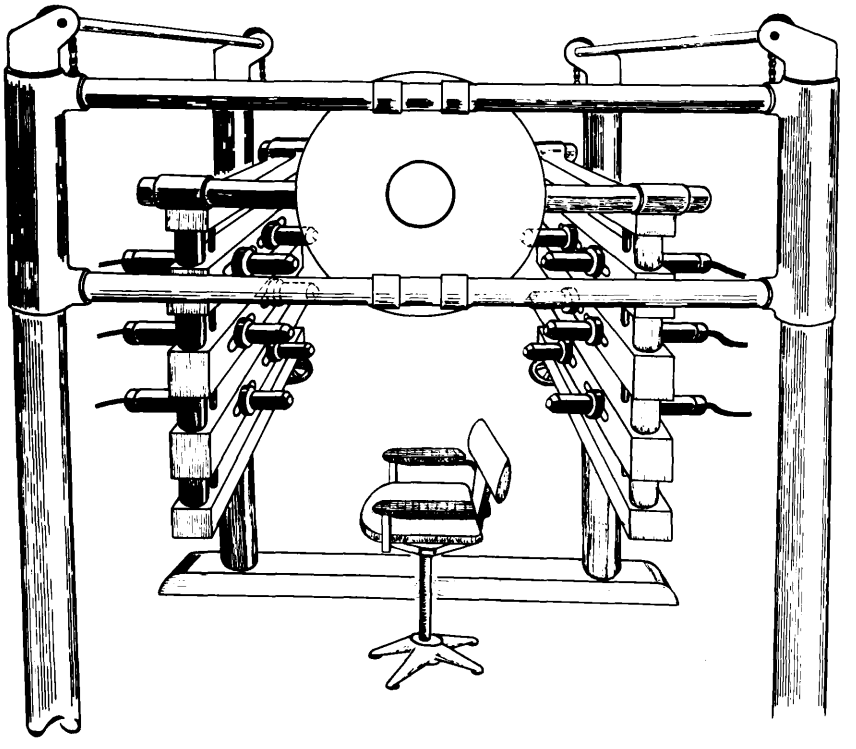

Figure 12. A perspective drawing of the gantry supporting the counting heads used in the detection of ^{133}Xe. The patient sits upright in the chair and the anterior and posterior battery of counters are lowered and advanced into position for the procedure. The position of the counting heads is shown.

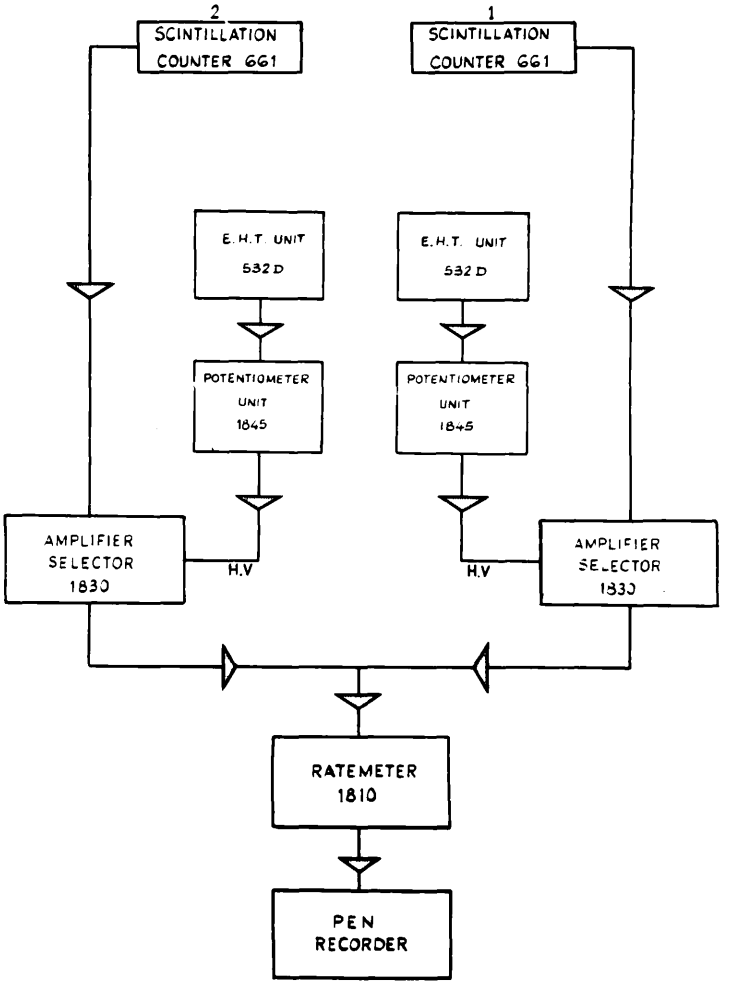

Figure 13. **A block diagram of the circuit used in counting and recording the surface activity of ^{133}Xe.**

Figure 14 (A) Photograph to show position of patient between batteries of counters, with shielded spirometer in position.

(B) Photograph of the bulky tower containing electronic equipment, ratemeters and recorders. The yellow trolley is the spirometer and closed circuit contained in a lead shield. The gantry and counting heads are shown.

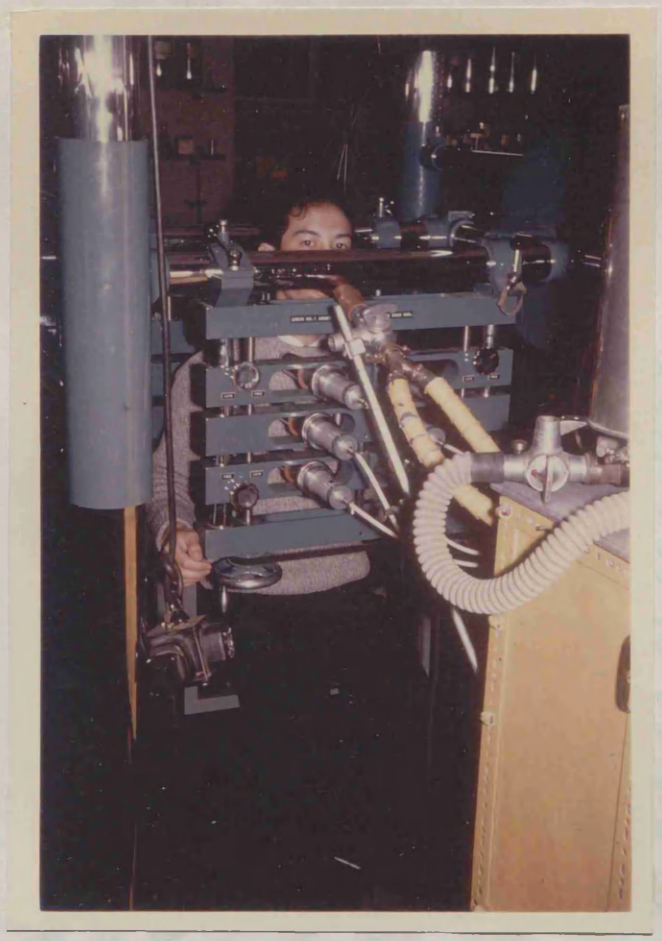

Figure 14 A.

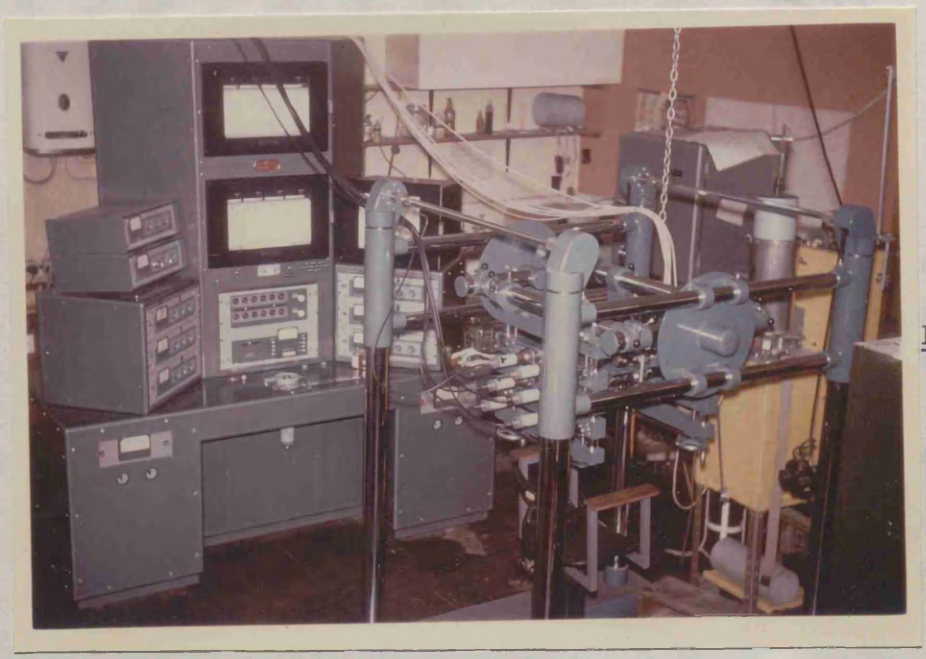

Figure 14 B

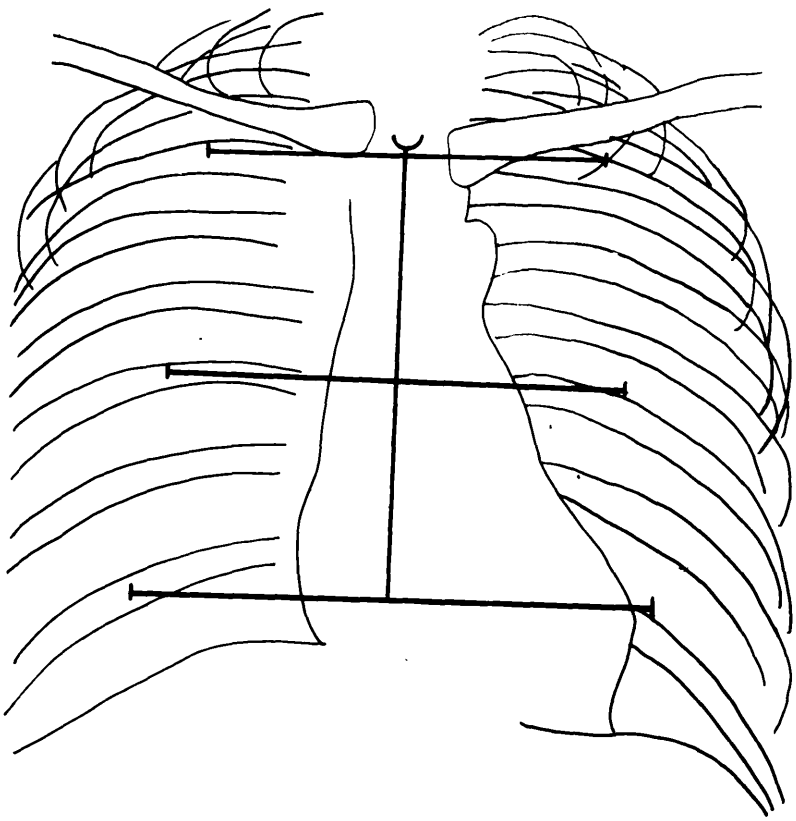

Figure 15. A tracing of a chest radiograph in inspiration in which the position of the counters are shown. They are placed equidistant from the mid-line in the upper, middle and lower zone of each lung. The semicircle between the clavicles represents the suprasternal notch which was used as a reference point.

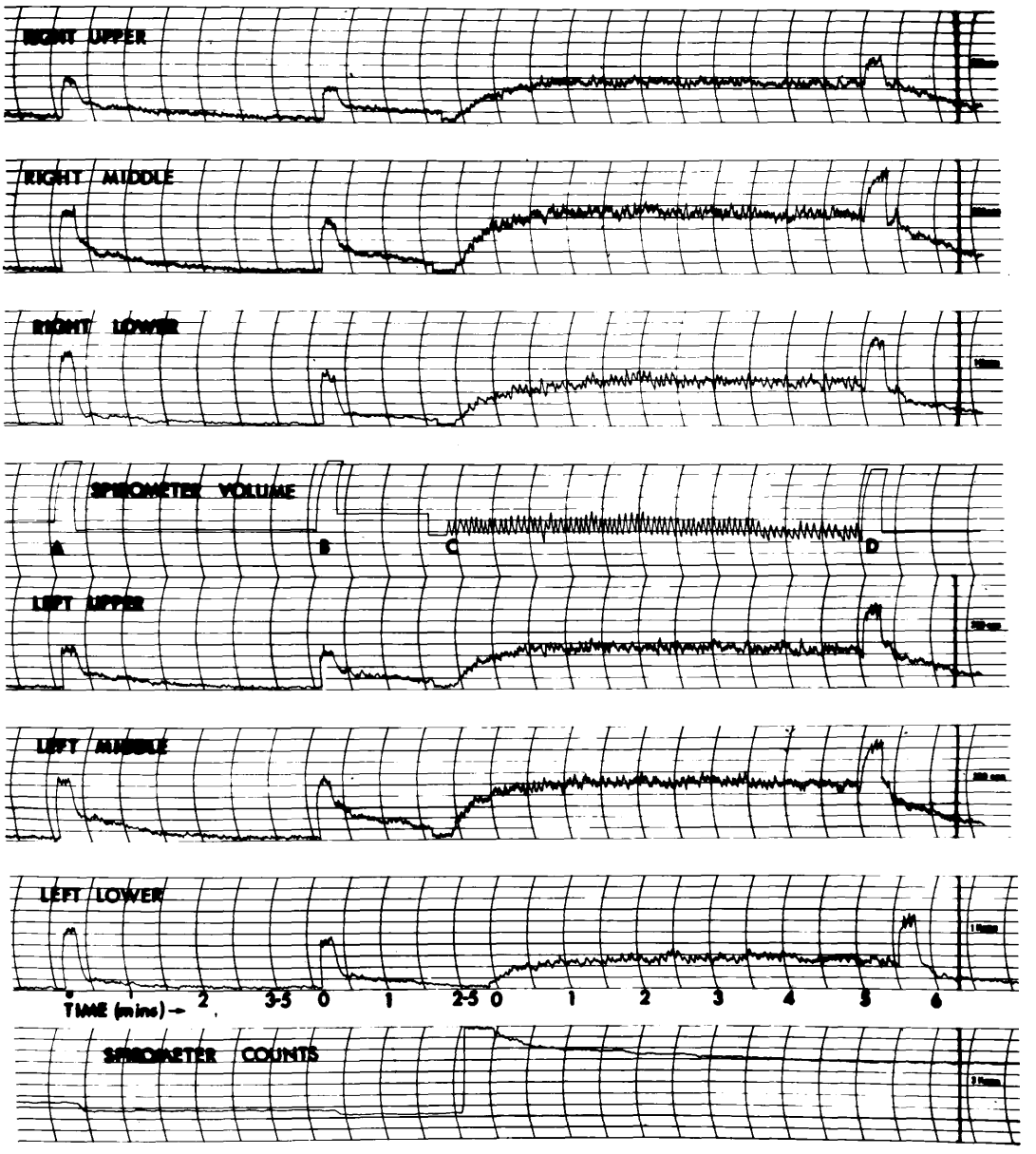

Figure 16. A tracing of the regional ventilation and perfusion ^{133}Xe procedure in a normal subject reduced approximately ten times. The right and left upper, middle and lower zones counting rates are shown at appropriate attenuations also the spirometer volume and count rates from 'hot' spirometer circuit. At A ^{133}Xe was perfused into the superior vena cava in saline. At B ^{133}Xe in air was inspired. C to D shows the rebreathing procedure ending with a breathholding period. On this particular occasion duplicates were not done and the spirometer counting rate had to be increased before the rebreathing procedure.

Figure 17. Photograph of the right upper, middle and lower zone and spirometer volume tracings during perfusion of ^{133}Xe in solution and a breathholding manoeuvre. The plateaus, after perfusion, are marked with horizontal lines as are the background counts before perfusion. Two points should be noted:

1.) The off scale deflection in the right upper zone before breath-holding as the radioactivity passes that counter in the superior vena cava.

2.) The rise in the background count immediately prior to injection as the syringe of isotope is brought near the patient.

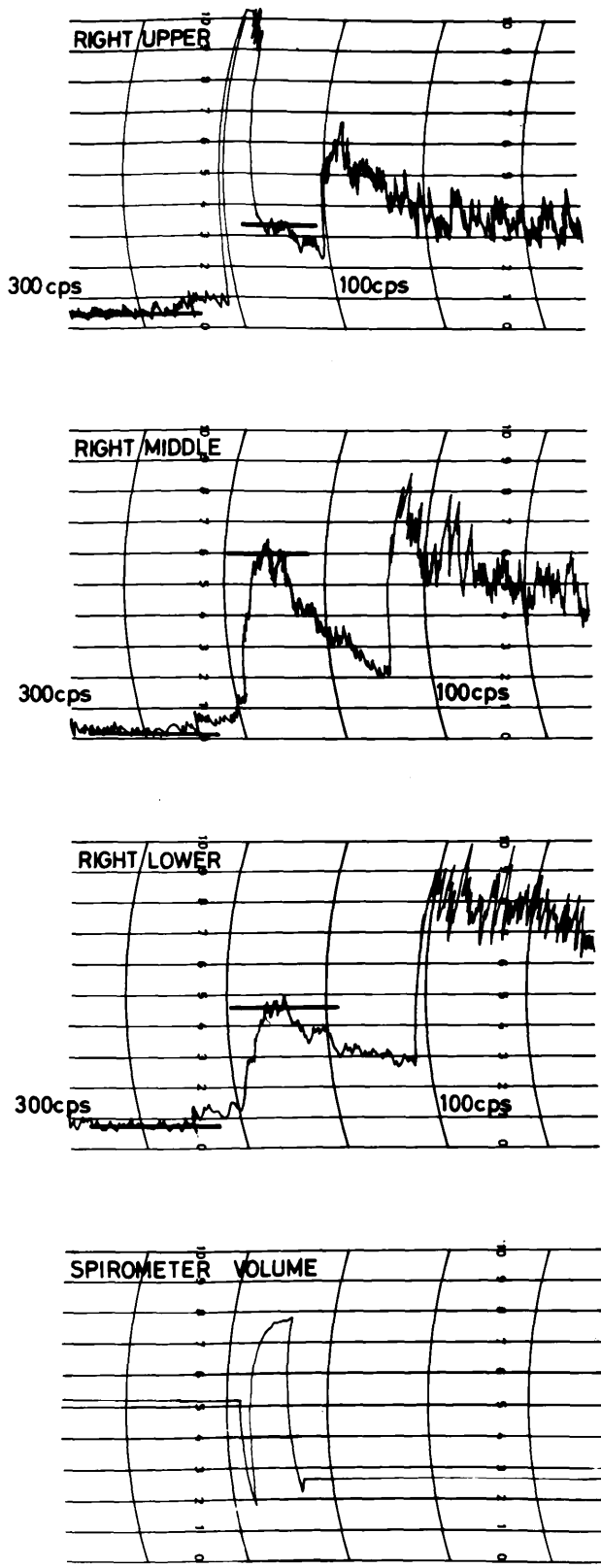
RIGHT UPPER
300 cps
100cps
RIGHT MIDDLE
300cps
100cps
RIGHT LOWER
300cps
100cps
SPIROMETER VOLUME

Figure 17.

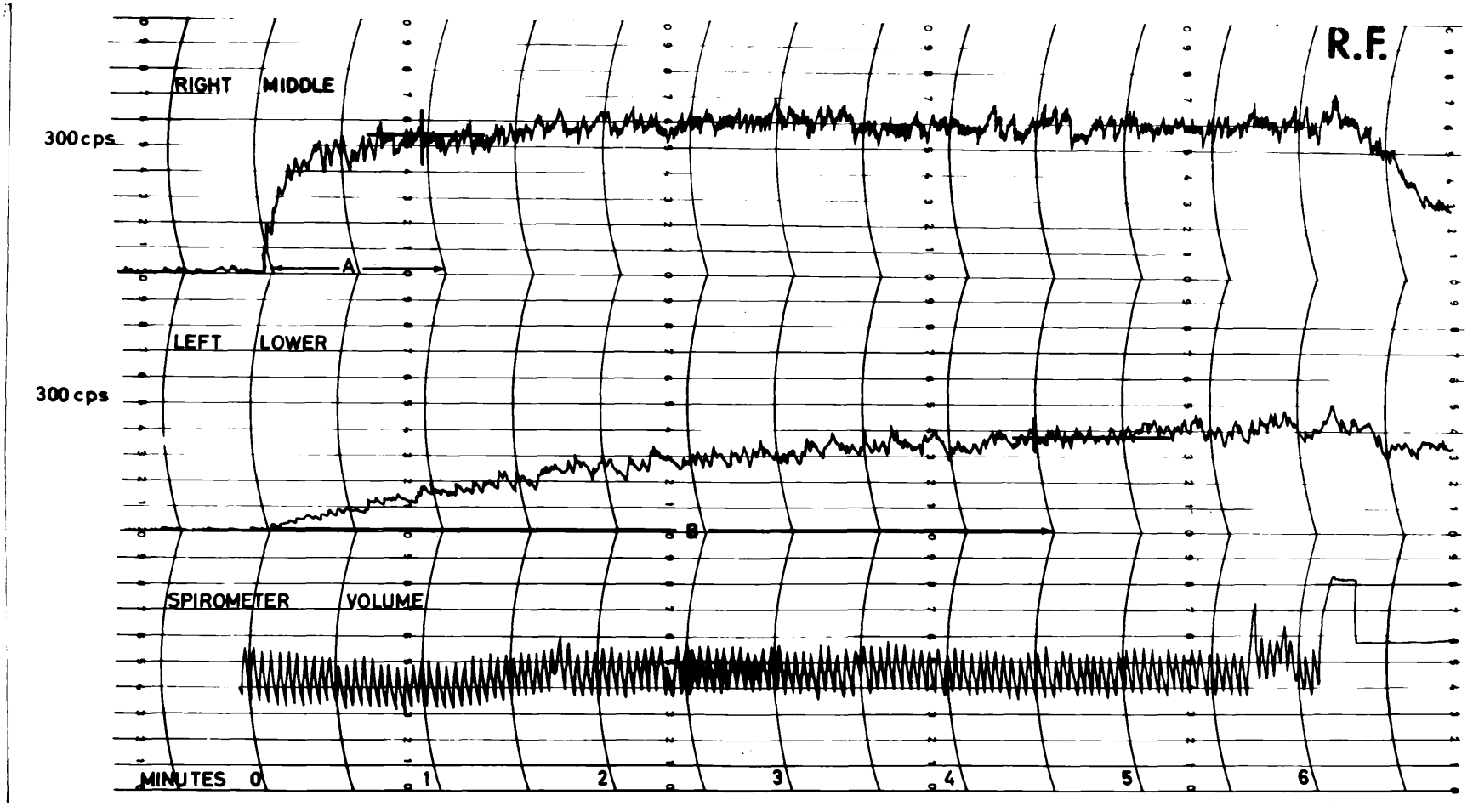

Figure 18. Illustration of a good 'wash in' mixing curve in the right middle zone recorded simultaneously with a poor 'wash in' curve in the left lower zone in the same patient. "A" represents the 90% mixing time in the right middle zone and "B" the 90% mixing time in the left lower zone.

TABLE I.

A statistical analysis of pairs of observations of ventilation and perfusion indices.

	Ventilation Indices	Perfusion Indices
Number of pairs	408	390
Mean value of first and second estimate.	1·004 0·998	0·989 0·987
Standard deviation of means	0·122 0·122	0·133 0·184
Correlation coefficient	0·964	0·986

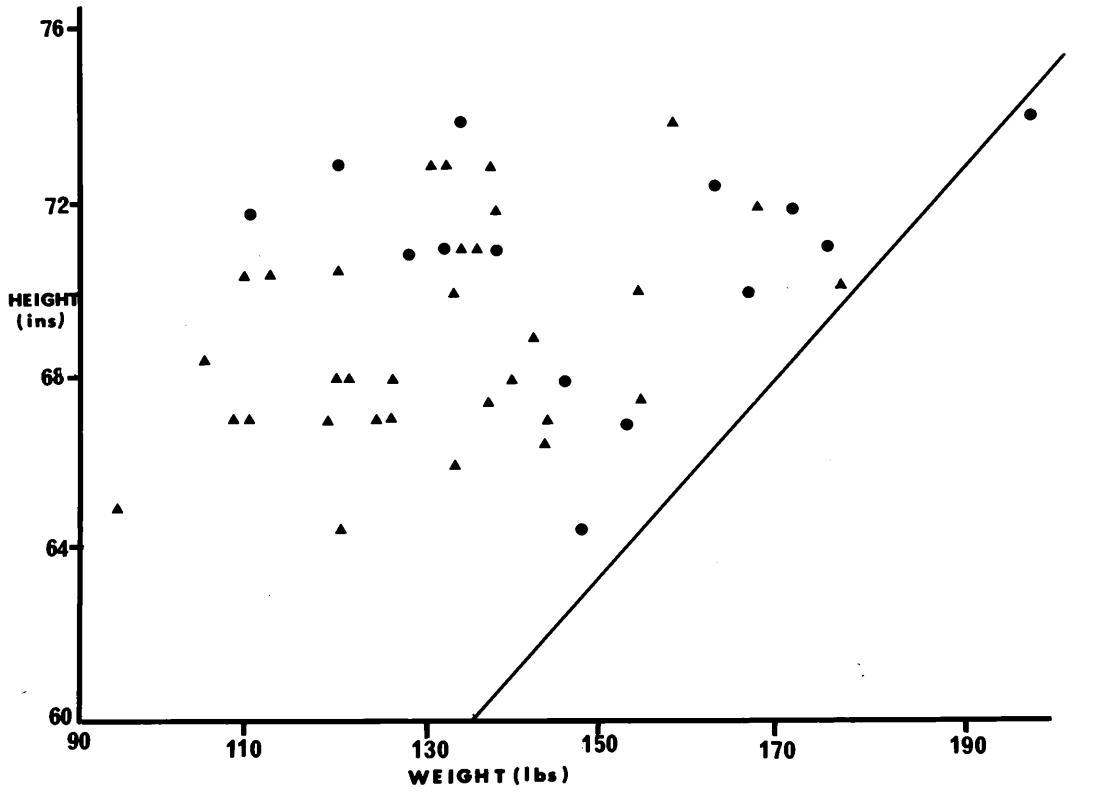

Figure 19. The height and weight of 46 men in Group I is shown. The dots represent patients with no bronchitis and the triangles patients with bronchitis. The straight line shows the average weight according to height for men from 40-50 years (Society of Actuaries 1959). All except 2 of these patients are underweight and 35 are 20 lbs. or more below their expected weight.

TABLE II

Summary of respiratory complaints in patients in Group I.

	With Bronchitis	Without Bronchitis	Total
	32 Patients	18 Patients	50 Patients (46male;4females)
Initial Complaint			
Cough	23 "	nil	23 "
Breathlessness	7 "	17 Patients	24 "
Cough and Breathlessness	2 "	nil	2 "
No Complaints	nil	1 Patient	1 "
Grade of Breathlessness			
I	0 Patients	1 Patient	1 Patient
II	0 "	3 "	3 "
III	4 "	3 "	7 "
IV	2 "	2 "	4 "
V	26 "	9 "	35 "
Recent Chest Infections.			
Grade 0	5 Patients	10 Patients	15 Patients
1	9 "	3 "	12 "
2	18 "	5 "	23 "
Length of history of initial complaint			
Mean Value	7·7 years	11·1 years	8·8 years
Age of Onset of Breathlessness.			
Mean Value	47·5 years	42·8 years	46·1 years
Length of history of breathlessness			
Mean Value	7·0 years	10·9 years	8·4 years
Mean Age	55·0 years	54·9 years	54·9 years

TABLE III

Comparison of smoking habits of patients in Group I with data from other studies. The results are presented as percentages of the total population studied.

	Group I	Higgins (1957)+	Olsen and Gilson (1960)*
Never Smoked	4%	3·8%	7·4%
Stopped Smoking	66%	11·5%	13·0%
1-14 cigs/day	8%	27·0%	44·4%
15-24 cigs/day	16%	57·5%	25·8%
25+ cigs/day	6%		9·3%

\+ Chronic bronchitic subjects.

* Population survey data.

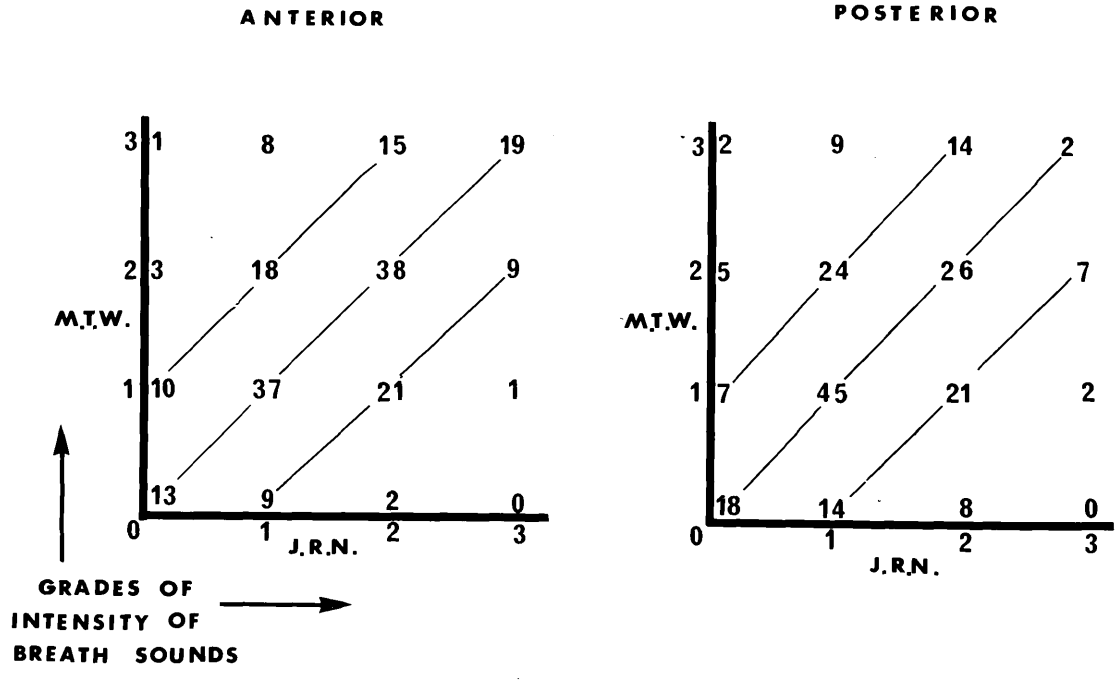

Figure 20. The grades of intensity of the breath sounds heard anteriorly and posteriorly are compared between two observers in 34 patients in Group I. The diagonal lines indicate complete agreement or only one grade of difference in their observations.

The observers are J.R. Nairn and M. Turner-Warwick.

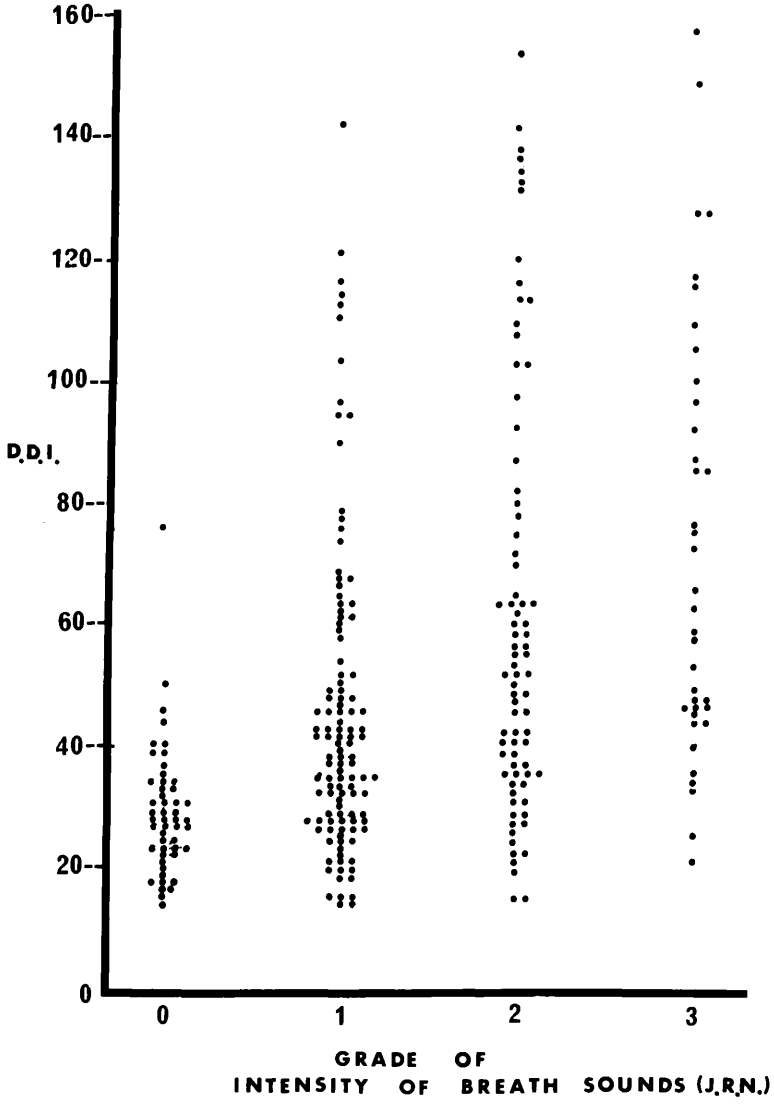

Figure 21. A comparison between the intensity of the breath sounds heard anteriorly in 47 patients in Group I and the dynamic distribution index in different zones. The observer is J.R. Nairn.

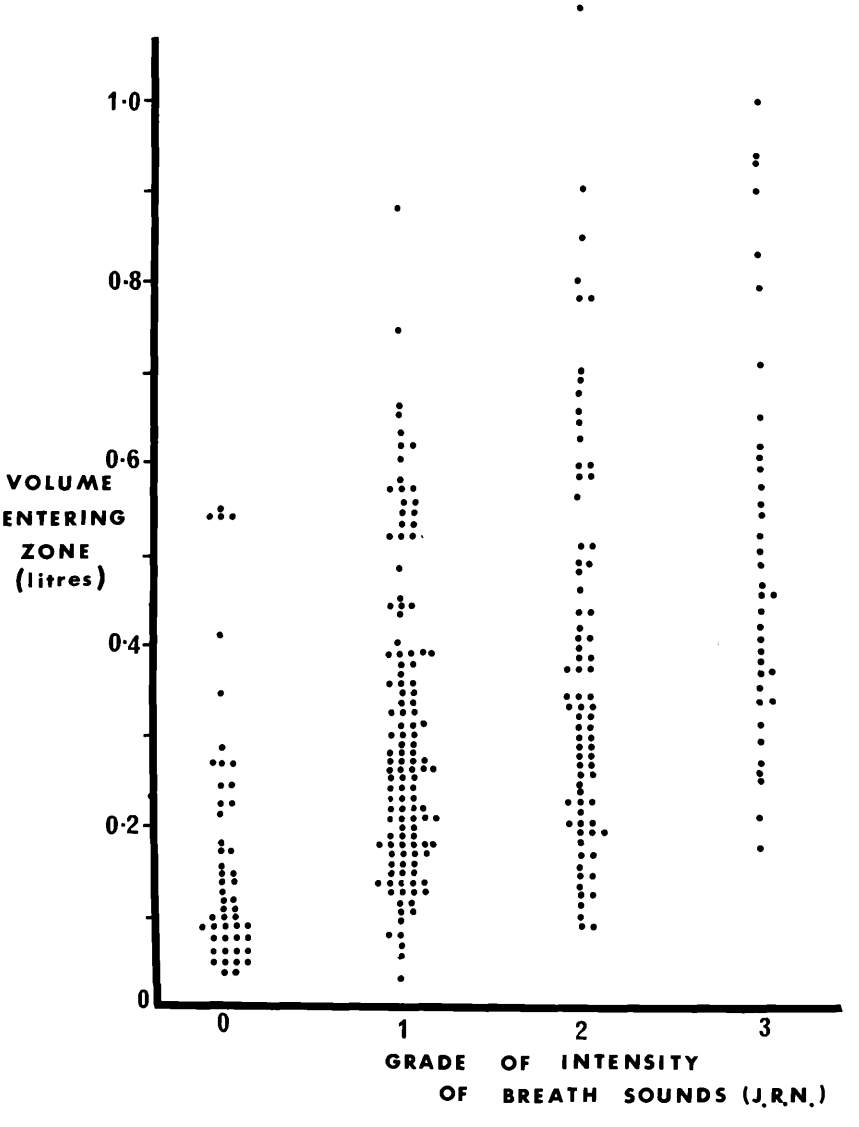

Figure 22. A comparison between the intensity of the breath sounds heard anteriorly in 47 patients in Group I and the volume of air entering different zones.
The observer is J.R. Nairn.

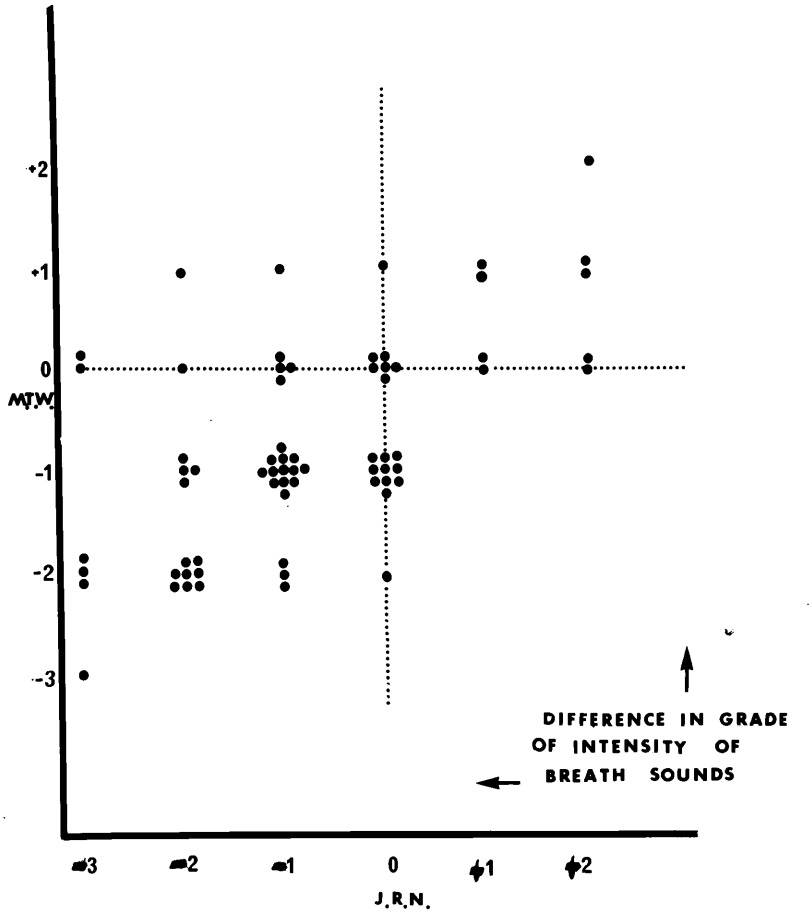

Figure 23. A comparison of the difference in the grade of intensity of the breath sounds between the top and the bottom of the lung as recorded by two observers, J.R. Nairn and M. Turner-Warwick. Thirty-four patients in Group I were examined. The line of complete agreement between the observers passes at a 45° angle through the crossing dotted axes shown from below left to upper right. The 2 points shown in the upper left quadrant are instances of complete disagreement between observers.

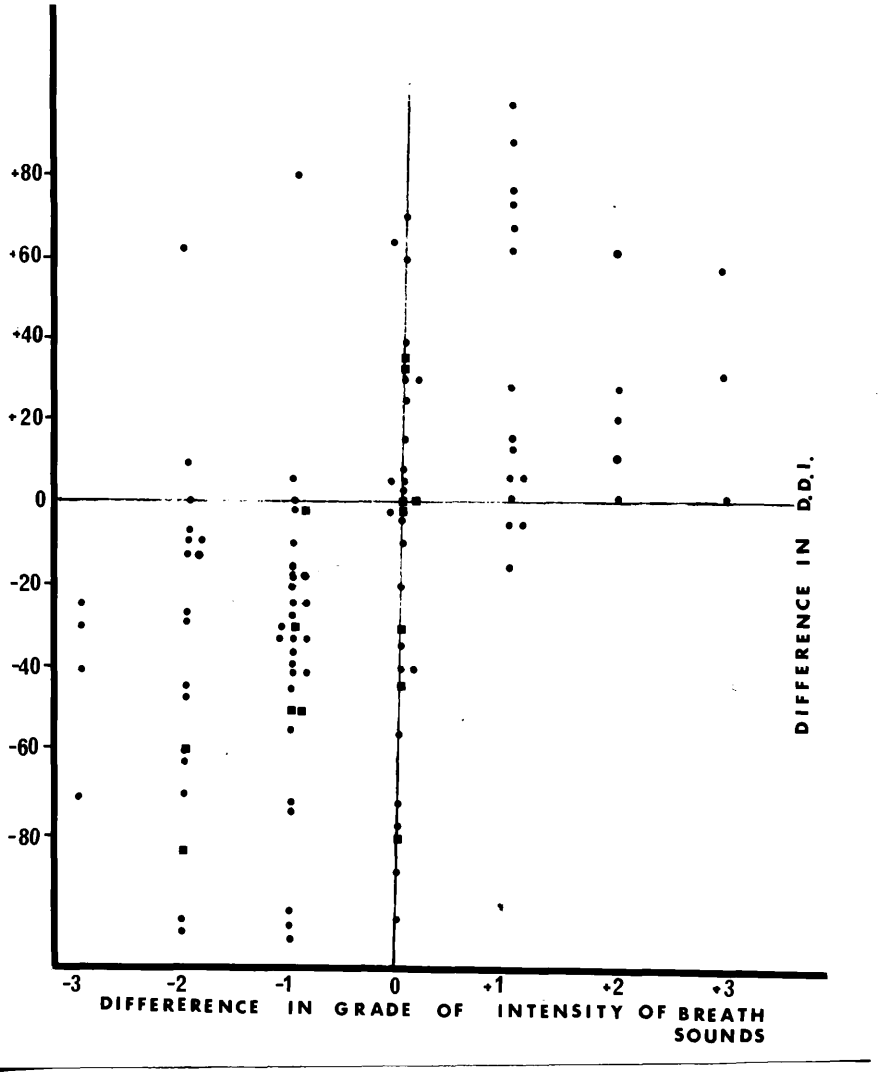

Figure 24. The difference between the grades of intensity of the breath sounds from top to bottom of the lungs is compared with the difference measured in the D.D.I. between these zones. The observer is J.R. Nairn. The results in 46 patients from Group I (dots) and 7 patients from Group II (squares) are shown.

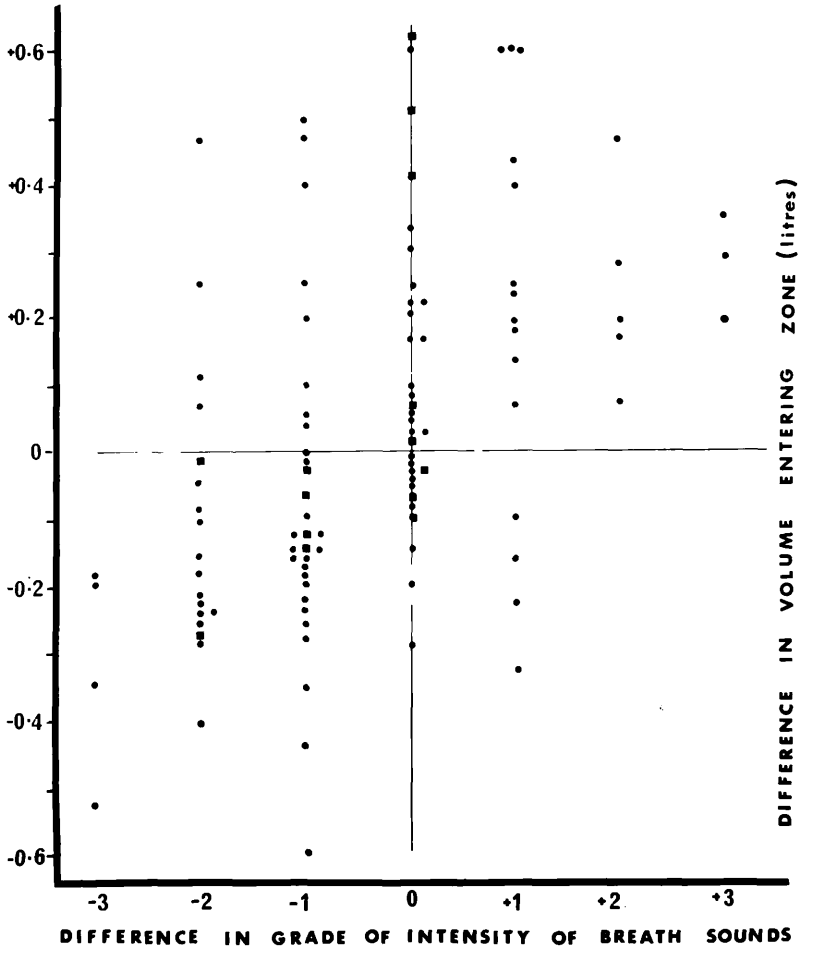

Figure 25. A comparison of the difference in the grade of intensity of the breath sounds from top to bottom of each lung and the difference in the volume of air calculated to enter the upper and lower zones.

The dots are patients in Group I and the squares depict patients in Group II.

Figure 26. Postero-anterior radiograph of J.W., a patient with generalised emphysema who complained of severe breathlessness (Grade V) but denied having a chronic productive cough. The diaphragm is flat and low (7th rib). The transverse diameter of the heart is 10·0 cms. and the transhilar diameter 11·5 cms. The pulmonary and hilar arteries are not dilated. There are small mid-lung vessels and vascular loss in all zones except the left upper zone. This patient had an $F.E.V._{1}$ of 500 ml. and a vital capacity of 1·80 litres. Intrapulmonary mixing was poor in all zones of the lung.

Figure 27. Postero anterior radiograph of a patient (A.P.) with extensive localised emphysema, who complained of breathlessness (Grade V) but had no bronchitis. The right dome of the diaphragm is curved at the level of the 7th anterior rib. The transverse diameter of the heart is 14·0 cms. and the trans hilar diameter 11·0 cms. The pulmonary artery is dilated but the hilar arteries are of normal size. The mid-lung vessels are small in the upper and middle zones and there is evidence of vascular loss in the upper zones. This patient (A.P.) had very poor overall lung function ($F.E.V._1$ = 600 ml.) but the lower zones showed normal intrapulmonary mixing.

Figure 28. Postero anterior radiograph of a patient (R.G.) with extensive localised emphysema who admitted to some breathlessness (Grade III) which was not severe and a productive cough. The diaphragm is curved between the level of the 6th and 7th anterior ribs. The transverse diameter of the heart was 11·5 cms. and the transhilar diameter 11·0 cms. The pulmonary artery is dilated but the hilar arteries are of normal size. The mid-lung vessels are small in both upper zones and the left middle and lower zones. Vascular loss is also evident in these zones. There is a demarcated bulla in the left lower zone (4 x 12 cms.) in size. This patient had an $F.E.V._1$ of 2 litres and a vital capacity of 3·80 litres. Only the right lower zone had normal intrapulmonary mixing.

TABLE IV

The mean values, standard deviations and significance levels of lung function tests in patients in Group I classified according to the radiological extent of emphysema.

	Generalised	Extensive Localised	Localised
Number of Patients	22	13	14
$F.E.V._1$ (ml.)	611·3 (± 243)	884·6 (± 1367)	1078·5 (± 640)
V.C. (litres)	2·20 (± 0·674)	3·04+ (± 0·988)	3·33* (± 0·0846)
% V.C.	53·8 (± 14·2)	69·3+ (± 17·8)	78·9* (± 14·1)
R.V./T.L.C.	69·7 (± 10·53)	59·2+ (± 10·48)	53·1* (± 10·7)
F.R.C. (litres)	6·11 (± 1·83)	5·58 (± 1·18)	5·26 (± 1·19)
% F.R.C.	166·8 (± 40·99)	145·8 (±27·05)	127·4+ (±34·21)
T.L.C. (litres)	7·52 (± 1·99)	7·40 (± 1·16)	7·06 (±1·54)
% Pred. T.L.C.	119·3 (± 24·21)	115·0 (± 16·6)	114·1 (± 20·2)
D_{LCO} mLCO/min/mm.Hg.	6·5 (± 1·96)	8·6 (± 3·05)	8·8 (± 2·12)
Rest Pa_{O_2} mm.Hg.	73·2 (±13·93)	89·1+ (± 6·58)	84·5* (± 8·09)
Rest Pa_{CO_2} mm.Hg.	45·7 (± 8·27)	40·9 (± 6·13)	41·7 (± 5·73)

+ = Significantly different (p = 0·01) from the generalised group.
* = Highly significantly different (p = 0·001) from the generalised group.

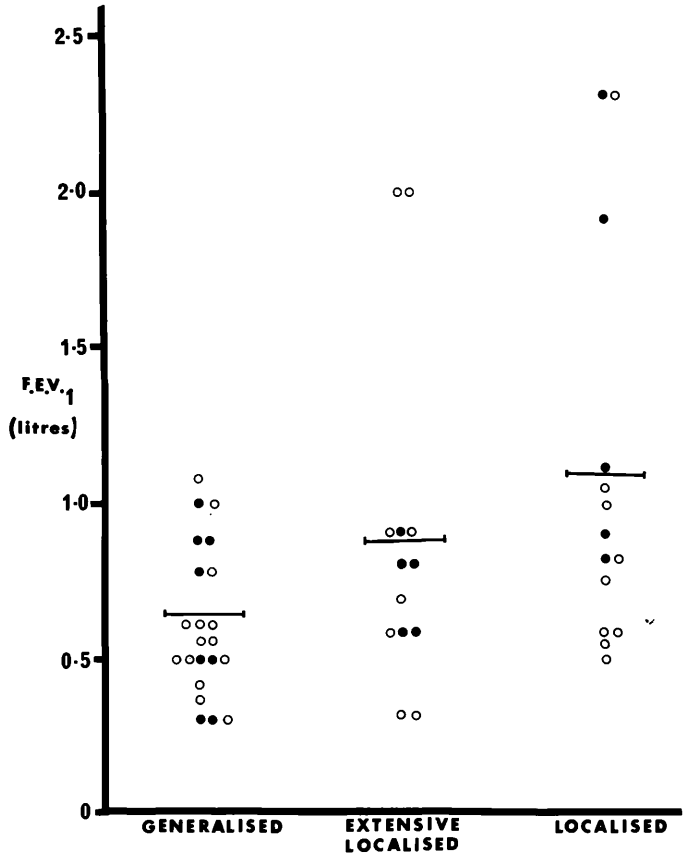

Figure 29. The values of forced expired volume in one second in patients in Group I according to the extent of emphysema radiologically. The horizontal bars represent the means in each group. Black dots are patients without bronchitis and empty circles are patients with bronchitis.

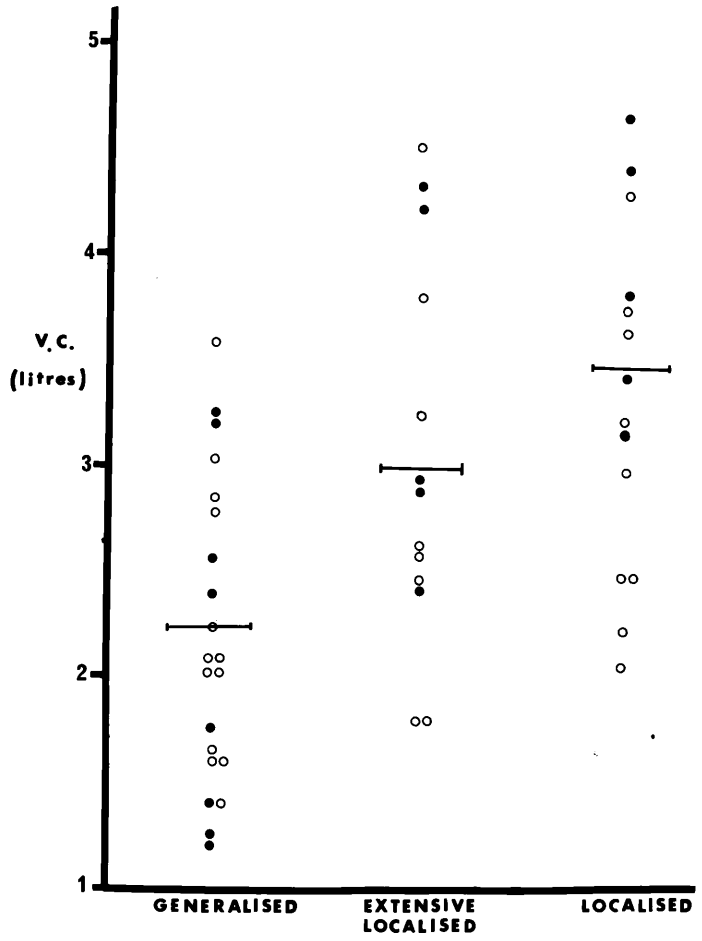

Figure 30. The values of vital capacity in patients in Group I according to the extent of emphysema radiologically. The horizontal bars represent the mean in each group. Black dots are patients without bronchitis and empty circles are patients with bronchitis.

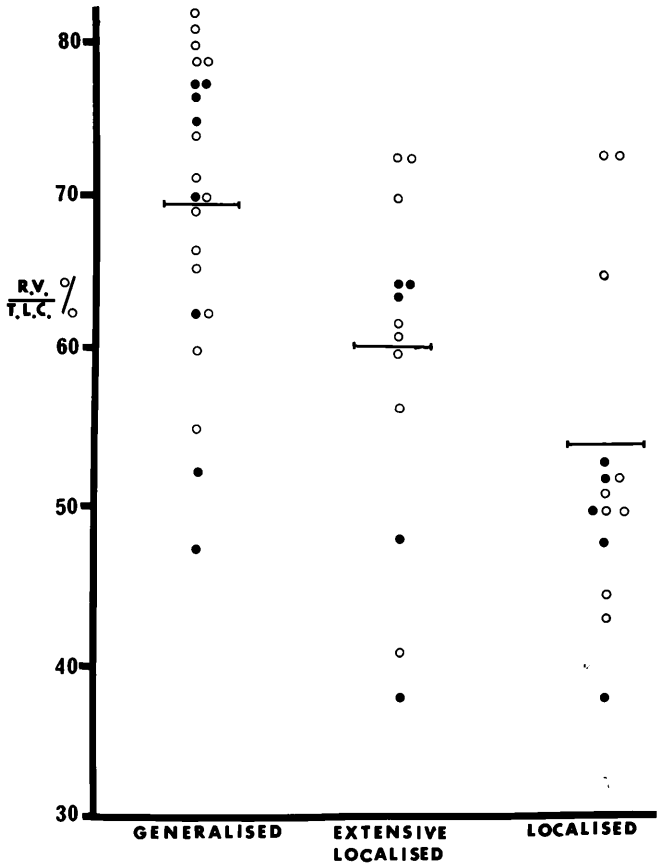

Figure 31. The values of the ratio of the residual volume to the total lung capacity expressed as a percentage in patients in Group I according to the extent of emphysema radiologically. The horizontal bars represent the mean in each group. Black dots are patients without bronchitis and empty circles are patients with bronchitis.

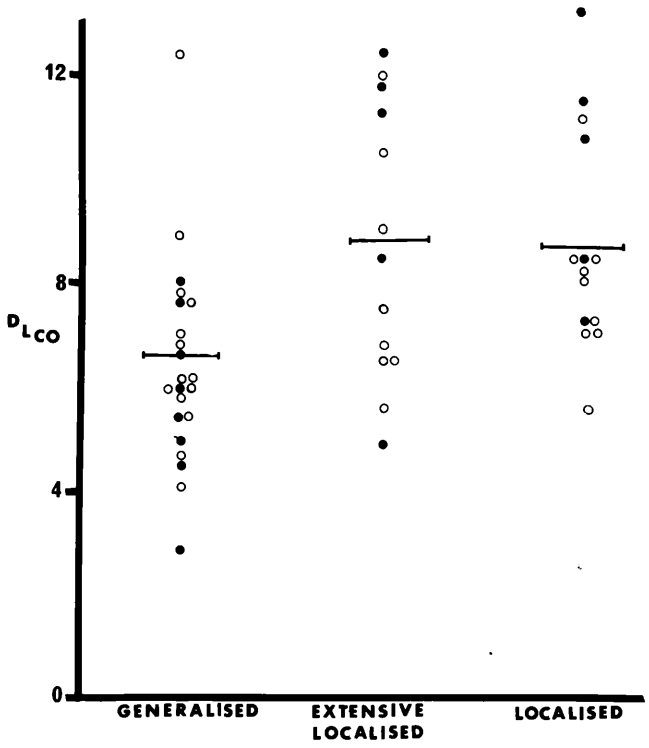

Figure 32. The diffusing capacity for carbon monoxide in ml.CO/minute/mm.Hg. in patients in Group I according to the extent of emphysema radiologically. The horizontal bars represent the mean in each group. Black dots are patients without bronchitis and empty circles are patients with bronchitis.

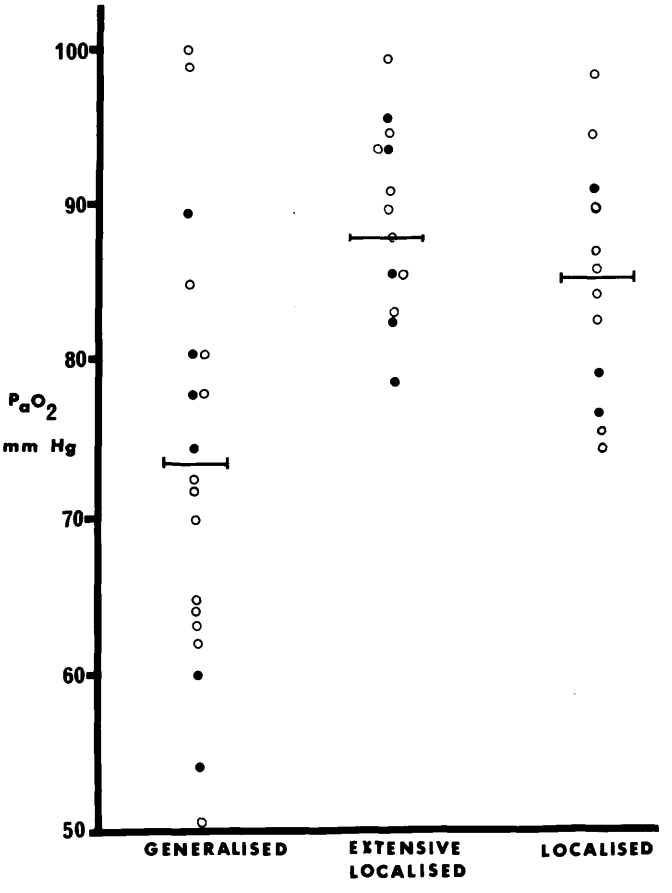

Figure 33. The resting arterial oxygen tension in patients in Group I according to the extent of emphysema radiologically. The horizontal bars represent the mean in each group. Black dots are patients without bronchitis and empty circles are patients with bronchitis.

TABLE V.

Mean values, standard deviations and significance levels of the functional residual capacity and total lung capacity expressed as a percentage of the predicted value and % RV/TLC in patients in Group I according to the shape of the diaphragm.

	Shape of Diaphragm	
	Curved	Flat.
Number of Patients	15	28
% $RV_{/TLC}$ *	55·1 ± 10·68	66·6 ±11·44
% Predicted F.R.C.	145·1 ± 35·21	154·2 ± 44·05
% Predicted T.L.C.	117·5 ± 19·49	119·6 ± 23·83

* p = 0·05.

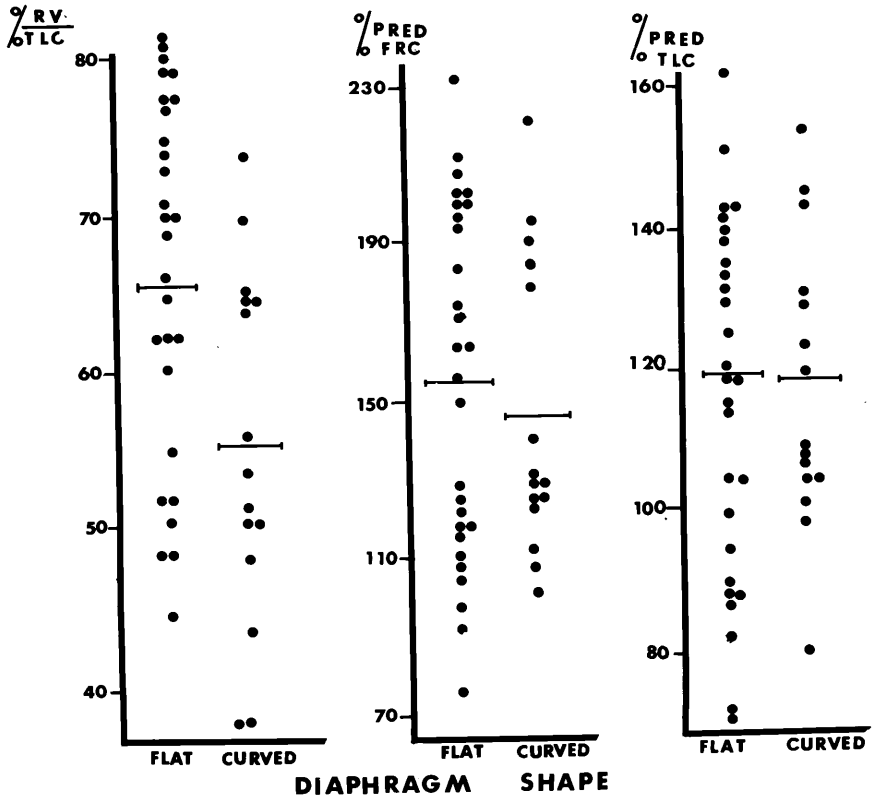

Figure 34. The relationship between the shape of the diaphragm seen radiologically and lung volumes. The residual volume to total lung capacity ratio is expressed as a percentage. The functional residual capacity and the total lung capacity are shown as a percentage of the predicted value. The patients are from Group I. The horizontal bars represent the mean in each group.

T A B L E VI

Mean Values, standard deviations and significance levels of the functional residual capacity and the total lung capacity expressed as a percentage of the predicted value and % RV/TLC in patients in Group I according to the level of the diaphragm.

	Level of Diaphragm	
	Normal	Low
Number of Patients	23	26
RV/TLC %+	55·6 ± 11·18	68·0 ± 12·53
% Predicted F.R.C.+	128·3 ± 28·41	169·1 ± 38·6
% Predicted T.L.C.*	105·0 ± 17·72	125·0 ± 21·12

+ = p = 0·001 * = p = 0·01

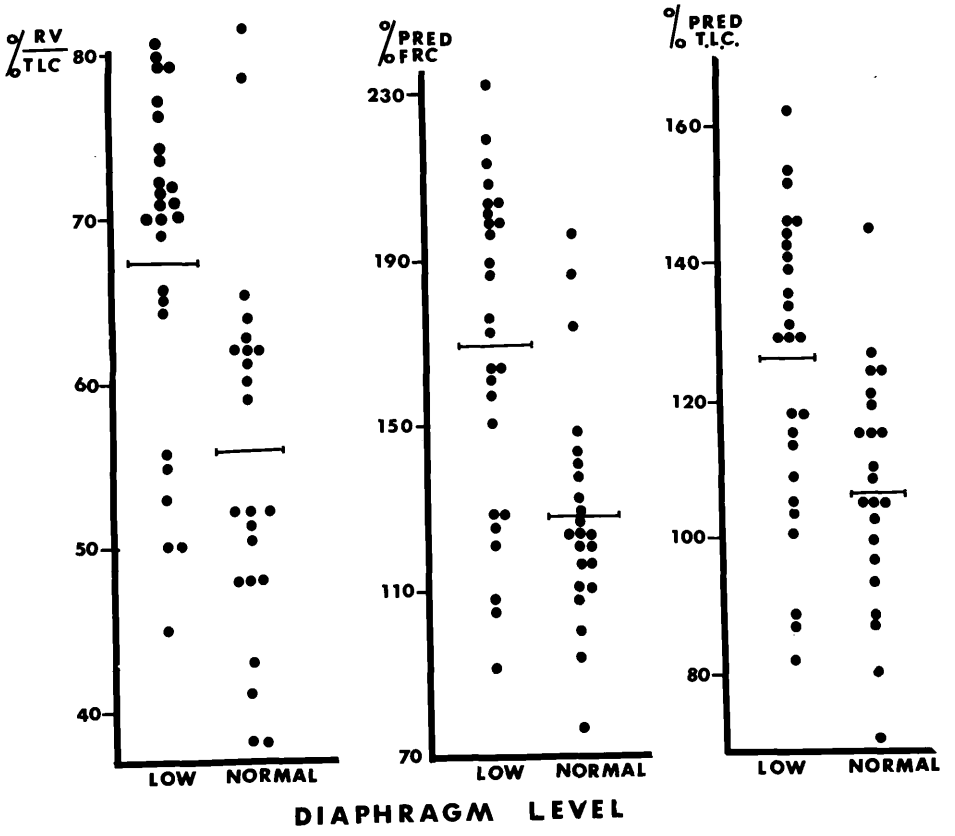

Figure 35. The relationship between the level of the diaphragm (according to the anterior ribs showing above the right dome of the diaphragm) and lung volumes in patients in Group I. The volumes are expressed as in figure 34. The horizontal bars represent the mean in each group. The diaphragm is lower than normal if the 7th or more anterior ribs are above the right dome of the diaphragm on inspiration.

TABLE VII

The mean values, standard deviation and significance levels between the lung volumes and the shape and level of the diaphragm are shown. Diaphragms which had one dome flat and the other curved are not included.

	Diaphragm Shape and Level.			
	Flat and low(1)	Flat and Normal (2)	Curved and low (3)	Curved and Normal (4)
Number of Patients	16	12	8	7
% Predicted F.R.C.	171·0 ± 44·3	132·1 ± 35·5	168·6 ± 35·9	119·7 ± 13·9
% Predicted T.L.C.	126·1 ± 23·3	102·2 ± 20·0	127·7 ± 20·7	105·8 ± 14·7
% $RV/_{TLC}$	71·4 ± 10·6	60·1 ± 11·1	60·1 ± 9·1	49·3 ± 10·8

Between 1 and 4 % Predicted F.R.C. p = 0·001
% Predicted T.L.C. p = 0·050
% $RV/_{TLC}$ p = 0·001

Between 1 and 2 % Predicted F.R.C. p = 0·050
% Predicted T.L.C. p = 0·050
% $RV/_{TLC}$ p = 0·050

Between 1 and 3 No significant difference

Between 2 and 3 % Predicted F.R.C. p = 0·050
% Predicted T.L.C. p = 0·050
% $RV/_{TLC}$ No significant difference

Between 2 and 4 No significant difference

Between 3 and 4 % Predicted F.R.C. p = 0·001
% Predicted T.L.C. p = 0·050
% $RV/_{TLC}$ p = 0·050

TABLE VIII.

Mean values, standard deviations and significance levels of the percentage of predicted F.R.C., T.L.C. and the $^{RV}/_{TLC}$% in patients in Group I according to the depth of the retrosternal translucent zone.

	Depth of the Retrosternal Translucent Zone	
	Normal	Large
Number of Patients	15	31
% $^{RV}/_{TLC}$ *	60·0 ± 10·58	64·4 ± 11·96
% Predicted F.R.C.*	136·8 ± 40·74	159·3 ± 36·74
% Predicted T.L.C.*	113·5 ± 25·74	119·2 19·08

* None of these values are significantly different.

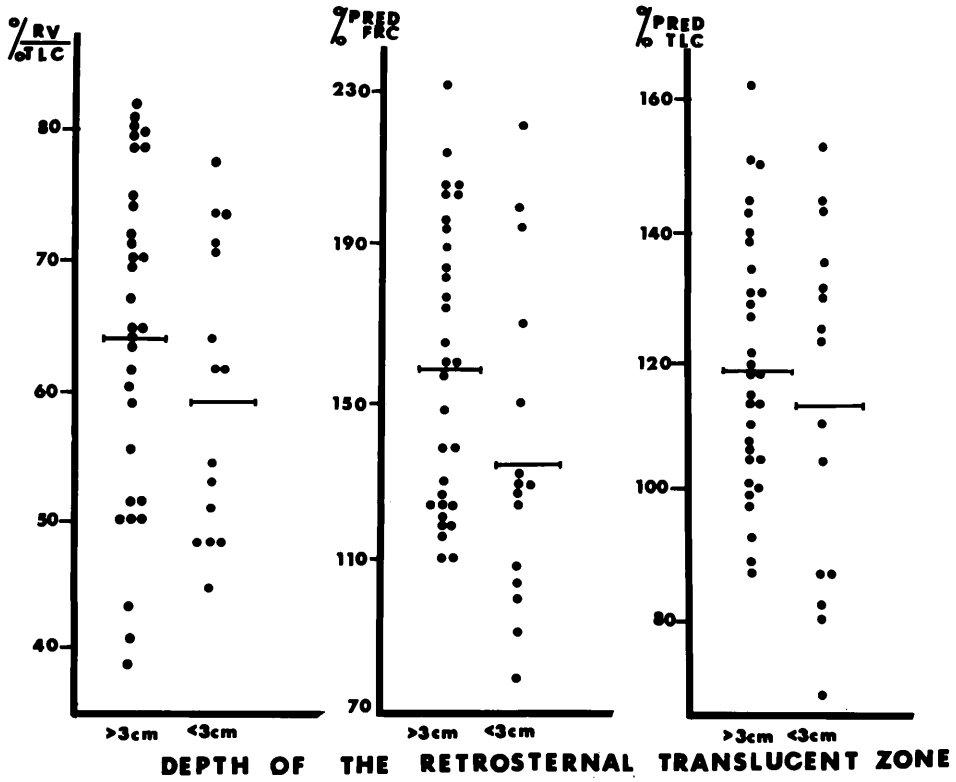

Figure 36. The relationship between the depth of the retrosternal translucent zone measured on a lateral film and lung volumes in patients in Group I. The volumes are expressed as in figure 34. The horizontal bars represent the mean in each group. (The retrosternal space is larger than normal if it is more than 3 cms.).

TABLE IX

The relationship between abnormally low zonal dynamic distribution indices in zones and the appearance of the mid-line vessels and evidence of vascular loss radiologically. Patients from Group I with and without bronchitis and patients from Group II are considered separately.

Diagnosis (no. of patients)	Zone	Percentage of Zones with a low D.D.I.			
		Small Mid-Lung Vessels and Vascular Loss (No. of zones)		Normal Mid-Lung Vessels With No Vascular Loss (No. of Zones)	
Emphysema (18)	Upper	(23)	78·0	20·0	(10)
	Middle	(21)	71·5	30·0	(15)
	Lower	(17)	100	46·7	(15)
Emphysema and Bronchitis. (32)	Upper	(29)	72·5	29·0	(24)
	Middle	(27)	85·0	80·0	(25)
	Lower	(32)	94·0	79·0	(24)
Bronchitis (8)	Upper	-	-	25·0	(16)
	Middle	-	-	75·0	(16)
	Lower	-	-	81·0	(16)

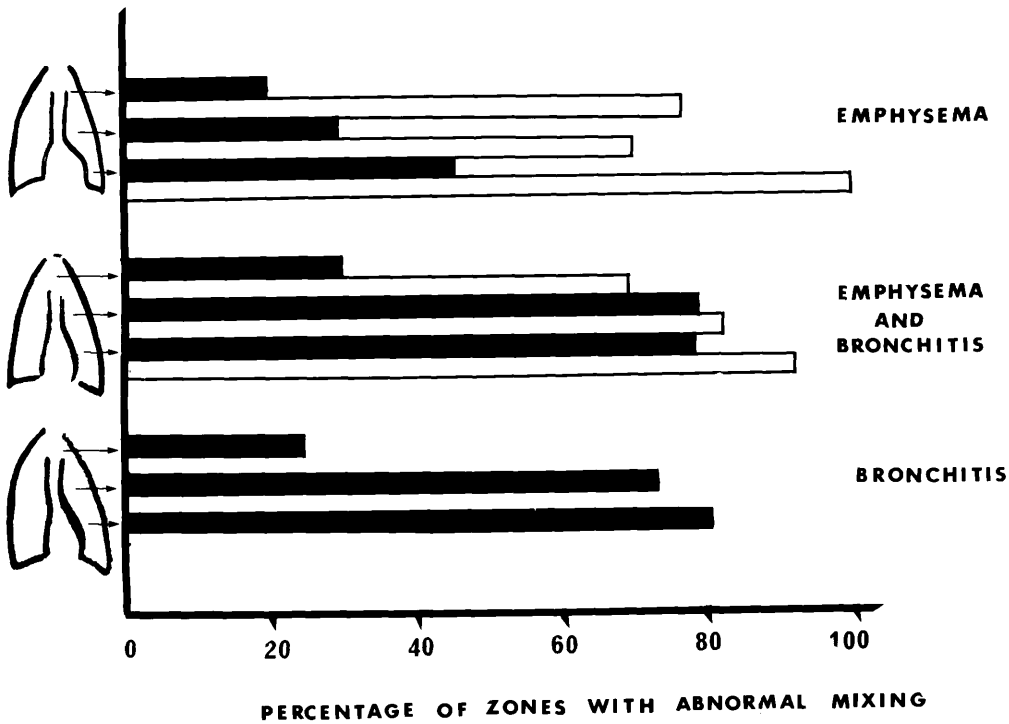

Figure 37. The relationship between poor intrapulmonary mixing and the radiological appearance of the mid-lung vessels and evidence of vascular loss in upper, middle and lower zones of the lung. Mixing is measured by the dynamic distribution index and is abnormal if this index is below the normal value for the zone in question. The black areas represent zones where there were normal mid-lung vessels and no vascular loss and the empty rectangular areas represent zones where there were small mid-lung vessels and evidence of vascular loss. The blocks labelled EMPHYSEMA are 18 patients in Group I who had no bronchitis. Those labelled EMPHYSEMA and BRONCHITIS are 31 patients in Group I with bronchitis and the BRONCHITIS patients are from Group II. There are no black zones in the latter group as there were no small mid-lung vessels or vessel loss in these patients.

TABLE X.

The relationship between poor perfusion and the radiological appearance of the mid lung vessels and vascular loss. Poor perfusion is judged to be present if the perfusion index is below normal for that zone. The patients with emphysema are from Group I, divided according to the presence or absence of bronchitis. The patients with bronchitis in this table are from Group II.

Diagnosis (number of patients.)	Zone	Percentage of zones with poor perfusion			
		Small Lung Vessels and Vascular Loss (no. of zones*)		Normal Lung Vessels and No Vascular Loss (no. of zones*)	
Emphysema (18)	Upper	(23)	4·3	(10)	0
	Middle	(21)	0	(10)	0
	Lower	(17)	76·0	(15)	0
Emphysema and Bronchitis (31)	Upper	(29)	0	(24)	4·2
	Middle	(27)	3·7	(25)	0
	Lower	(32)	78·1	(24)	29·2
Bronchitis (8)	Upper	(-)	-	(16)	0
	Middle	(-)	-	(16)	0
	Lower	(-)	-	(16)	68·8

* The reason for the discrepancy in the number of zones shown is the occurrence of small lung vessels and no vascular loss or normal lung vessels and vascular loss in the zones omitted from this table.

TABLE XI

The mean and ranges of values of the forced expired volume in one second ($F.E.V._1$) static lung volumes and diffusing capacity at rest and during exercise in patients in Group I.

Test	Mean Value	Range	Number of Patients
$F.E.V._1$ (ml.)	824	250 - 2300	50
$F.E.V._1/F.V.C.\%$	34·10	19 - 64	50
V.C. (litres)	2·76	1·2 - 4·7	50
F.R.C. (litres)	5·60	3·11-9·80	50
R.V. (litres)	4·84	2·19-9·00	50
T.L.C. (litres)	7·32	4·19-10·5	50
$R.V./T.L.C.$ %	61·50	34 - 88	50
$D_{L_{CO}}$ at rest ml.CO/min/mm.Hg.	7·89	3·0 -16.1	50
$D_{L_{CO}}$ during exercise " " " "	12·17	4·5 - 24·2	40
% Extraction CO at rest	30·14	17 - 48	50

TABLE XII

The mean values of arterial blood gas tensions at rest and after exercise* in patients in Group I. Derived values are also shown.

	Mean Value	Range	Number of Patients
Pa_{O_2} (mm.Hg.) at rest	83·5	53- 99·5	45
Pa_{O_2} (mm.Hg.) after exercise	79·5	56-104·5	33
Pa_{CO2} (mm.Hg.) at rest	43·2	32·5-62·0	45
$P_{A-a}O_2$ difference (mm.Hg) at rest	17·33	2·5-48·7	25
$\dot{V}_A$ (l/min) at rest	4·8	2·4- 7·8	25
V_D/V_T at rest	0·552	0·36-0·70	25

* The Pa_{CO_2} after exercise has not been considered for reasons described in the text.

TABLE XIII.

The mean, standard deviation and significance of the difference between arterial blood gas tensions at rest and after exercise in patients in Group I considered according to the presence or absence of bronchitis.

	With Bronchitis			Without Bronchitis			Significance Level.
	Mean	± S.D.	Number Of Patients	Mean	± S.D.	Number Of Patients	
Pa_{O_2} (mm Hg) at rest.	82·4	12·29	30	84·6	12·45	15	Not Signif.
Pa_{O_2} (mm Hg) after ex.	77·7	12·69	21	82·7	16·25	12	Not Signif.
Pa_{CO_2} (mmHg) at rest	45·2	8·85	30	39·4	4·65	15	p 0·01
$\dot{V}_A$ l/min at rest	4·36	1·40	15	5·54	1· 37	10	p 0·05
V_D/V_T at rest	0·584	0·25	15	0·506	0·10	10	Not Signif.
P_A-$a0_2$ mm.Hg	18·03	12·60	15	16·87	24·20	10	Not Signif.

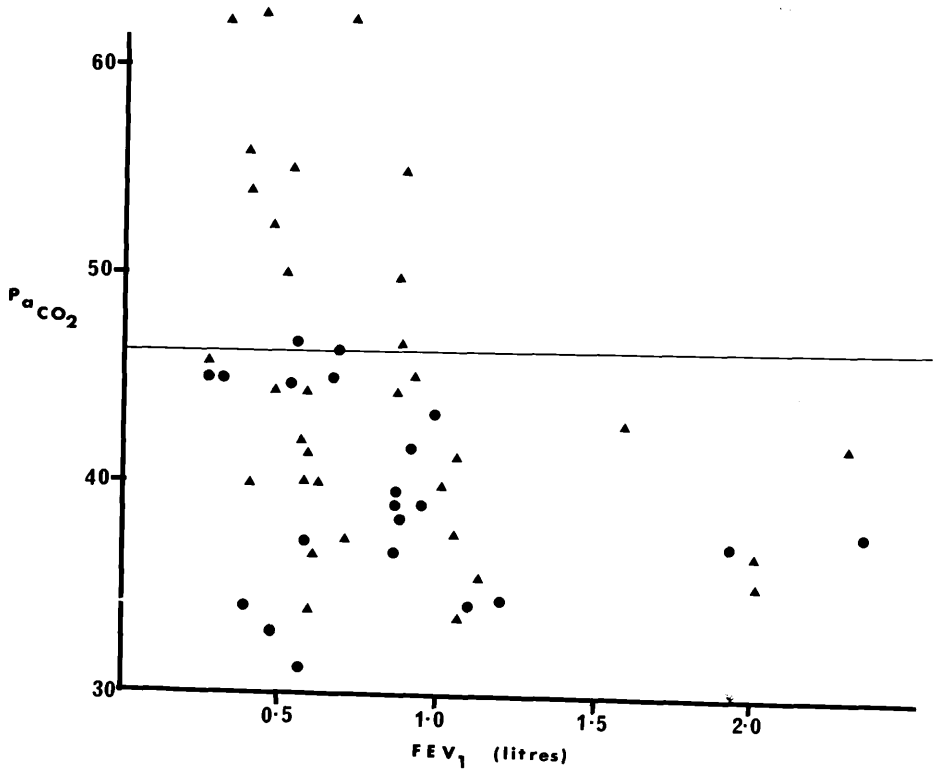

Figure 38. The arterial carbon dioxide tension ($PaCO_2$) in mm.Hg. and the forced expired volume in one second in patients in Group I with emphysema. The black dots are patients with no chronic bronchitis and the triangles patients with chronic bronchitis. The straight line depicts the upper limit of the normal range of $PaCO_2$ in this laboratory.

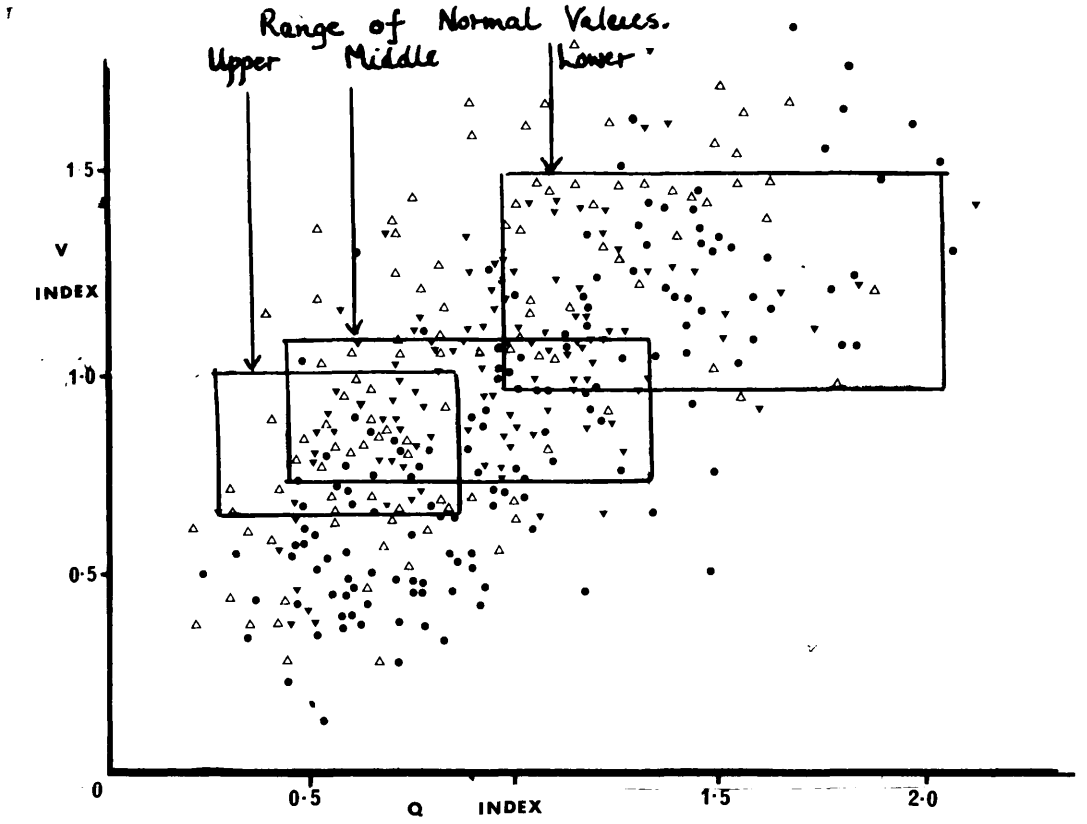

Figure 39. A comparison of the ventilation (V) and perfusion (Q) indices in patients in Group I. The empty triangles are measurements from the upper zone, the black triangles the middle zone, and the black dots from the lower zone.

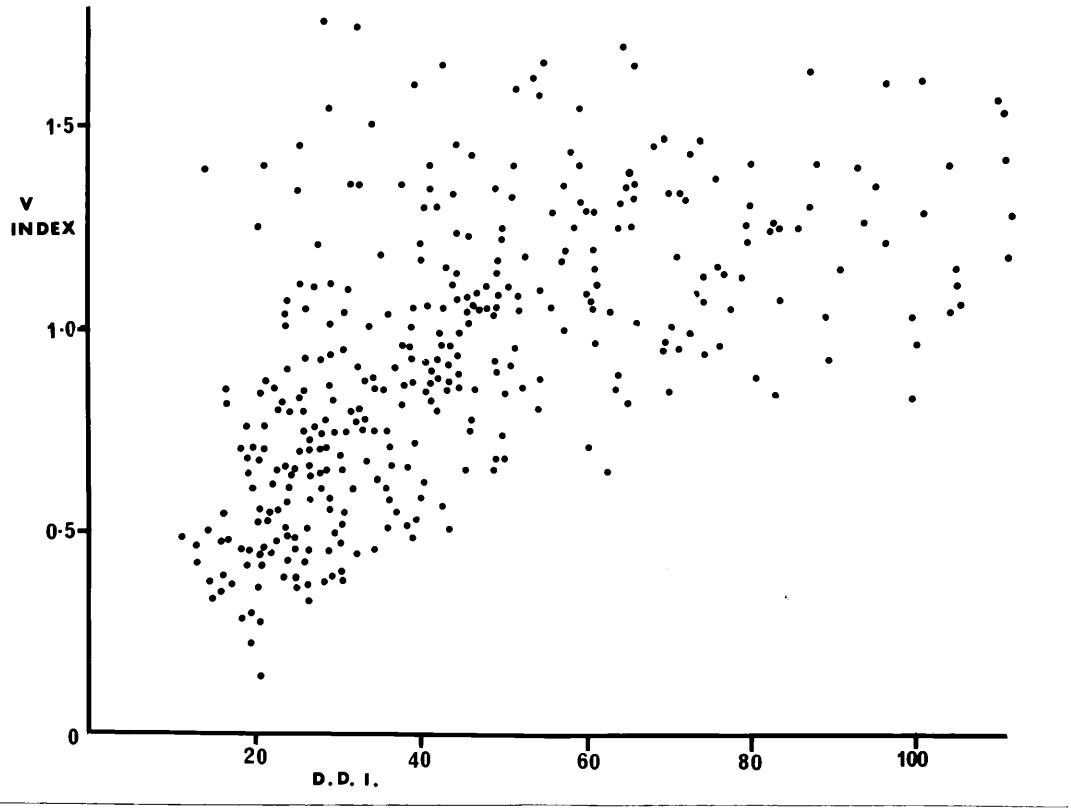

Figure 40. A comparison between the ventilation (V) index and the dynamic distribution index (D.D.I.) in all zones in patients in Group I.

TABLE XIV.

The distribution of impairment in regional function in patients in Group I using the dynamic distribution index.

Regional Function Impairment	No. of Patients	Coding*
All Zones	8	222
All Zones Except 1 Upper Zone	5	122
All Zones Except Both Upper Zones	13	022
Lower Zones and 1 Middle Zone	5	012
Lower Zones Only	9	002
Upper and Middle Zones and 1 Lower Zone	8	221
Upper and Middle Zones only	2	220

* The coding is for ease of reference. The first, second and third number in the series refers to the upper, middle and lower zones respectively. The number itself refers to the number of zones in the lungs with a lower D.D.I. than normal.

For the purposes of comparison with total lung function data these patterns of impairment regionally have been considered in 4 approximately equal groups according to the brackets of the coding shown.

TABLE XV.

Mean Values, ranges (in brackets), and standard deviations of total lung function tests in 4 groups of patients from Group I defined according to impairment in regional lung function.

Total Lung Function Tests	GROUPS ACCORDING TO REGIONAL IMPAIRMENT IN FUNCTION			
	222 / 122	022	221 / 220	012 / 002
F.E.V_1(ml) *	661 ± 212·3 (250–2,000)	715 ± 205·7 (400–1050)	1230 ± 252·0 (350–2300)	817 ± 411·1 (300– 1100)
V.C. (l)	2·58 ± 1·014 (1·2–4·5)	2·61± 0·762 (1·4–3·8)	3·24 ± 1·180 (1·6–4·7)	2·65± 0·805 (1·4–4·4)
F.R.C.(l)	6·01 ± 1·44 (3·11–7.66)	5·26 ± 1·50 (3·32–8·40)	5·90 ± 1·35 (4·05–7·80)	5·34 ± 1·86 (3·08–9·80)
RV/TLC %	64·6 ± 12·49 (38–79)	60·4 ± 11·66 (45 – 80)	59·0 ± 14·39 (41–82)	61·4 ± 14·25 (38 – 77)
D_{LCO} Rest mlCO/min/Hg	6·64 ± 2·97 (3·0–11·4)	7·43 ± 1·85 (4·6–11·8)	8·76 ± 2.45 (5·7–12·6)	8·56 ± 3·13 (4·7–13·5)
D_{LCO} Ex. ml.CO/min/Hg	10·9 (8·4–15·2)	11·7 (4·5–18·2)	13·4 (5·8–24·2)	12·4 (5·9–19·8)
	* p >0·001 between 221/220 and 022 and 012/002			
Pa_{O_2}(rest) mm.Hg.*	77·6±16·09 (53·0–96·5)	79·1±10·67 (72·5–99·5)	88·9±9·20 (72·0–98·5)	79·4 ± 10·54 (64·0 – 99·0)
Pa_{O_2} Ex. + mm. Hg.	75·3 ± 9·70 (58·0–85·0)	74·5 ± 10·39 (57·5–100)	92·0 ± 7·86 (56·0–104)	79·3 ± 16·2 (58·5– 104)
Pa_{CO_2} rest mm.Hg.	43·7 ± 9·83 (32·5–62·0)	45·5 ± 9·06 (33·0–62·0)	43·4 ± 6·35 (36.0–56·0)	41·8 ± 9·29 (33·0–56·0)
P_A-a_{O_2} diff.	18·4 (7·4 – 24·9)	18·3 (2·5 –25·4)	13·2 (3·0–29·3)	17·2 (6·8–27·8)
V_D/V_T 0	0·52 ± 0·089 (0·37–0·62)	0·62 ± 0·100 (0·41–0·70)	0·49 ± 0·084 (0·36–0·62)	0·58 ± 0·029 (0·56–0·64)
	* p >0·05 between 221/220 and other 3 groups.			
	+ p>0·01 between 221/220 and 222/122 and 022.			
	0 p>0·5 between 221/221 and 022			

Figure 41. Postero anterior radiograph of R.T., a patient from Group II with chronic obstructive bronchitis. This is "chronic bronchitis gone wrong". The right dome of the diaphragm is curved and at a level midway between the 6th and 7th anterior rib. The transverse diameter of the heart was 12·5 cms. and the transhilar diameter 10·5 cms. The pulmonary artery is dilated (the transverse diameters of the arteries basalis on 24 and 23 mm. left and right, respectively). The mid-lung vessels are normal except for dilated vessels in the apical zones and there is no vessel loss.

TABLE XVI.

A summary of the symptoms and history of 9 patients selected from Group I and 7 patients selected from Group II for the 'emphysema' and 'bronchitis' groups.

	EMPHYSEMA	BRONCHITIS
Average Age	54·7 yrs.	57·7 yrs.
Average age at onset of breathlessness	41·8 yrs.	51·3 yrs.
Number of years of breathlessness	12·8 yrs.	6·4 yrs.
First Symptom ..... Cough	-	6 Patients
Breathlessness	9 Patients	1 Patient
Average grade of breathlessness	4·7	4·1
Incidence of chest infections in past 3 years, i.e. more than a week incapacitated, and with sputum.		
None	5 Patients	1 Patient
1	2 Patients	0 Patients
2+	2 Patients	6 Patients
History of episode of heart failure	0 Patients	4 Patients

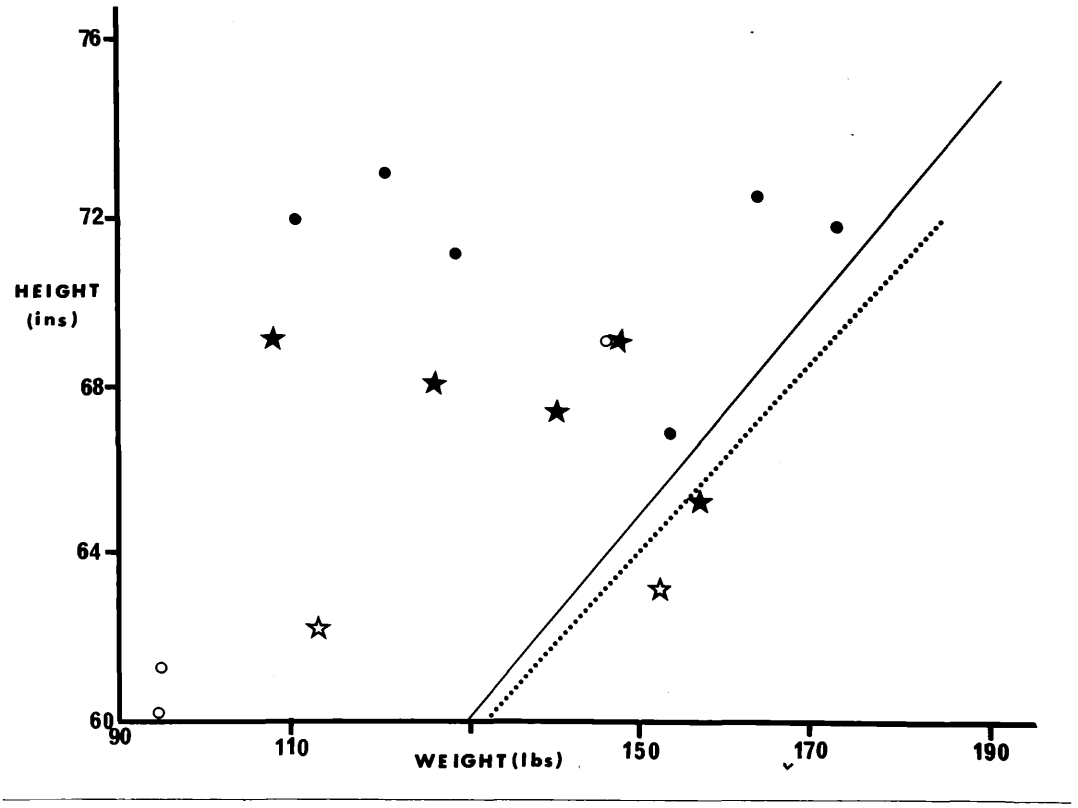

Figure 42. Height and weight of 7 patients with bronchitis from Group II and 9 patients from Group I with emphysema selected as described in the text. The stars show the bronchitic patients and the circles the emphysematous. Males are the solid symbols and females are depicted by outlined symbols. The dashed line represents the average weight for height in males and continuous line applies to females (Society of Actuaries, 1959). These lines apply to the same age group as the patients studied.

TABLE XVII

The patients selected from Group I and II for the 'emphysema' and 'bronchitis' groups with their age, sex, smoking habits, haemoglobin concentration and E.C.G. findings.

ject	Age	Sex	Smoking Habits	Hb (gms.)	E.C.G. Findings*
PHYSEMA GROUP					
C.	59	M	Moderate	15·3	Normal Pattern
. H.	55	F	Moderate	14·9	Normal Pattern
.M.	63	M	Ex. Moderate	13·1	Normal Pattern
P.	44	F	Ex. Light	13·4	-
Pl.	55	F	Ex. Light	15·4	RV +
P.	40	M	Ex. Moderate	15·0	Normal Pattern
W.	55	M	Ex. Moderate	14·4	RV +
J.	58	M	Light	14·0	Possibly RV+
Mah.	62	M	Ex. Moderate	17·5	RV +
an (± SD)				14·78(± 1·27)	
NCHITIS GROUP					
M.	60	M	Ex.Moderate	16·8	RV +
M.	64	M	Light	16·1	RV +
K.	62	M	Moderate	13·8	Ischaemic changes
T.	48	M	Ex. Heavy	17·2	RV +++
Sc.	60	F	Non Smoker	17·8	RV +
Pat.	51	F	Moderate	14·3	RV +
R.	59	M	Light	16·1	Normal Pattern
an (± SD)				16·01(± 1·36)	

The E.C.G. evidence of right ventricular hypertrophy (RV+) in cor pulmonale is according to the criteria of Towers (1966).

TABLE XVIII

Mean values and standard deviations, and significance, of total lung function tests in 9 patients from Group I and 7 patients from Group II selected for the 'emphysema' and 'bronchitis' groups.

	Emphysema	Bronchitis	Significance
$F.E.V._1$ (ml.)	628	636	
$F.E.V._1$/ F.V.C.	31·2	35·7	
V.C. (litres)	2·54 ± .94	2·22 ± 0·42	-
% Predicted V.C.	62·2 ± 16·12	62·9 ± 6·31	-
F.R.C. (litres)	6·05 ± 1·60	4·76 ± 0·47	-
% Predicted F.R.C.	172·3 ± 34·79	149·4 ± 22·63	-
T.L.C. (litres)	7·64 ± 1·62	6·46 ± 0·68	-
% Pred. T.L.C.	126·8 ± 15·33	116·1 ± 11·66	-
R.V./T.L.C.	66·6 ± 11·83	66·1 ± 5·45	-
At Rest			
D_{LCO} (ml.CO/min/mm.Hg)	6·9 ± 3·09	7·6 ± 1·97	-
Minute Ventilation (l/min)	10·12	8·64	-
% Extraction CO	28·7 ± 9·3	32·0 ± 3·74	-
During Exercise			
D_{LCO} (ml.CO/min/mm.Hg)	10·83 ± 5·41	10·68 ± 5.06	-
Minute Ventilation (l/min)	18·42	15·22	
At Rest			
Pa_{O_2} (mm.Hg)	75·2 ± 12·25	66·5 ± 10·05	-
Pa_{CO_2} (mm.Hg)*	42·4 ± 3·24*	53·1 ± 4·48*	*
pH	7·39	7·36	
% Satn. Hb	92·81 ± 4.15	89.74 ± 4·24	-
A-a P_{O_2} gradient (mm.Hg)	15·9 ± 4.09	13·8 ± 11·27	-
V_A l/min.	5·1 ± 1·10	3·8 ± 0·67	-
V_D/V_T	0.57 ± 0·256	0·62 ± 0·075	-
Minute Ventilation L/min.	12·3	9·42	-

* p = 0·001

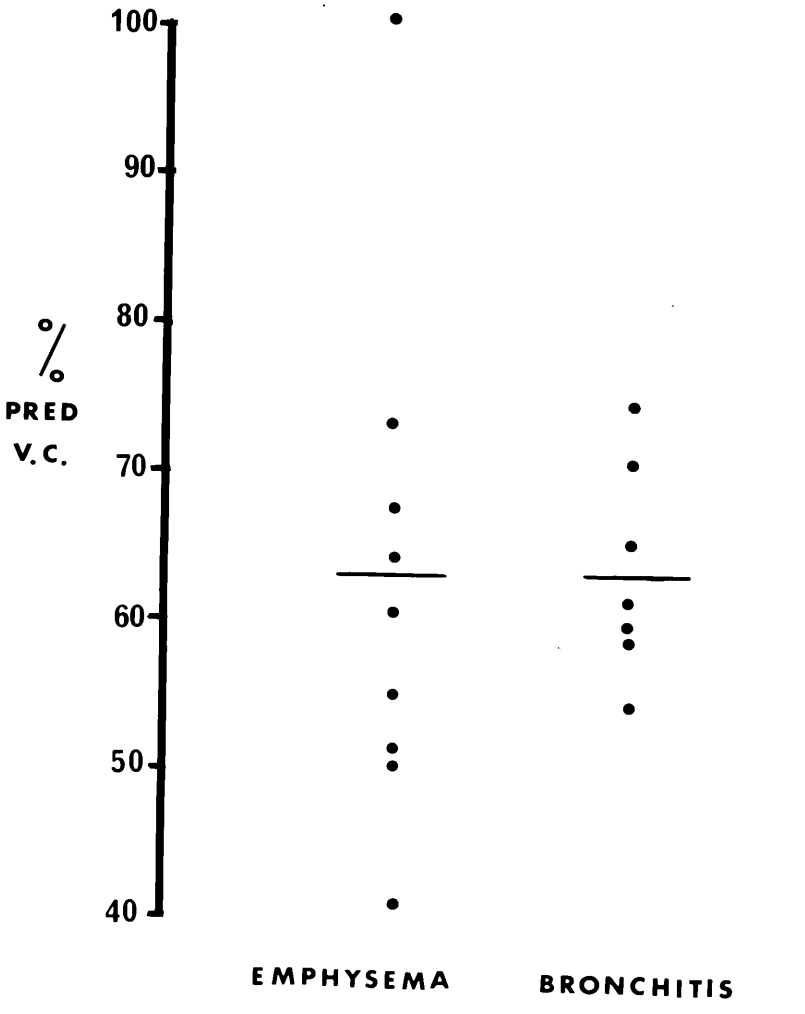

Figure 43 The vital capacity expressed as a percentage of the predicted value in 9 patients with emphysema and 7 patients with bronchitis. The mean value is shown by a horizontal bar in each group.

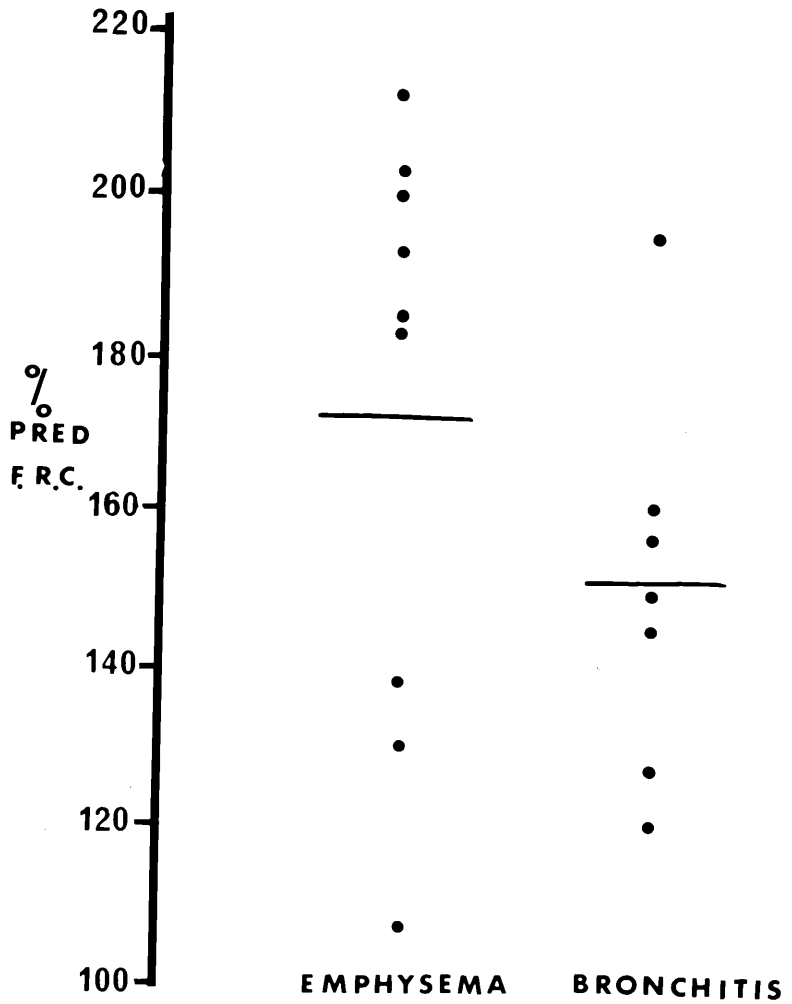

Figure 44. The functional residual capacity expressed as a percentage of the predicted value in 9 patients with emphysema and 7 patients with bronchitis. The mean value is shown by a horizontal bar in each group.

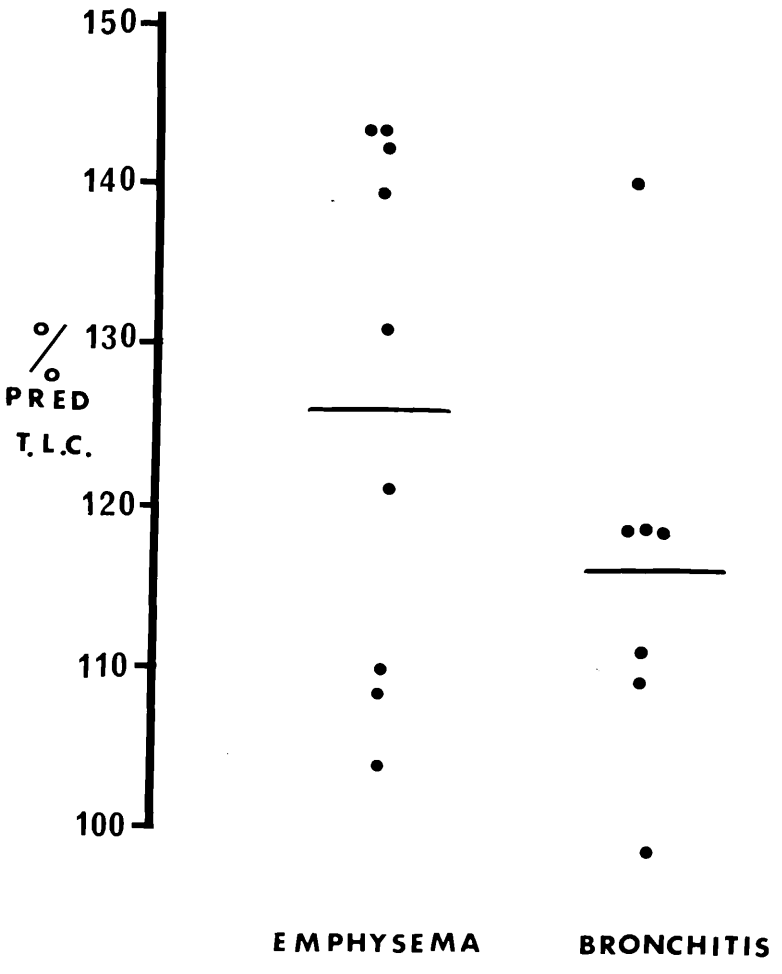

Figure 45. The total lung capacity expressed as a percentage of the predicted value in 9 patients with emphysema and 7 patients with bronchitis. The mean value is shown by a horizontal bar in each group.

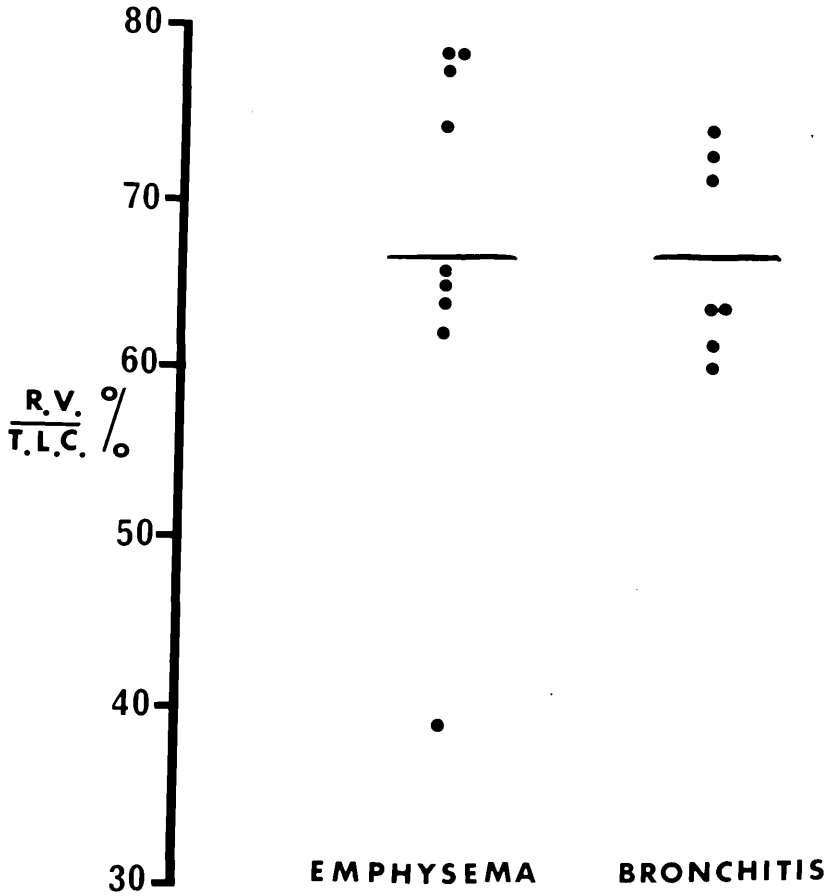

Figure 46. The ratio of the residual volume to the total lung capacity in 9 patients with emphysema and 7 patients with bronchitis. The mean value is shown by a horizontal bar in each group.

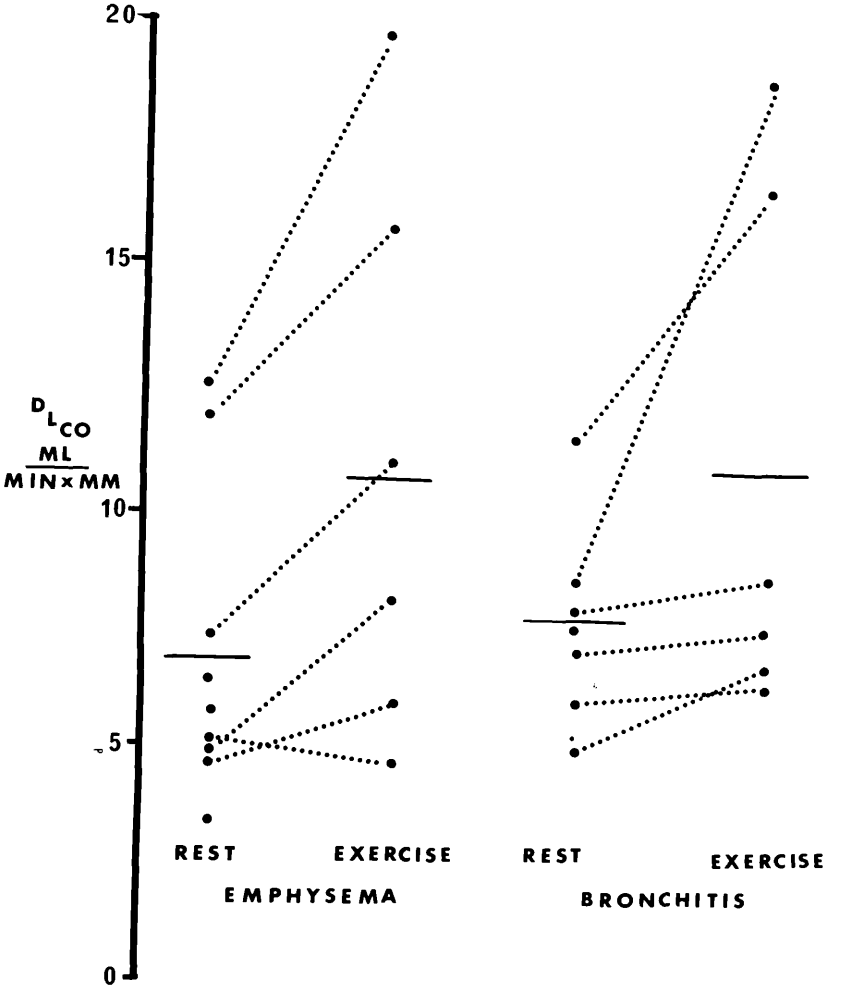

Figure 47. The steady state diffusing capacity in 9 patients with emphysema and 7 patients with bronchitis measured at rest and during stepping exercise. The mean value is shown by a horizontal bar in each group.

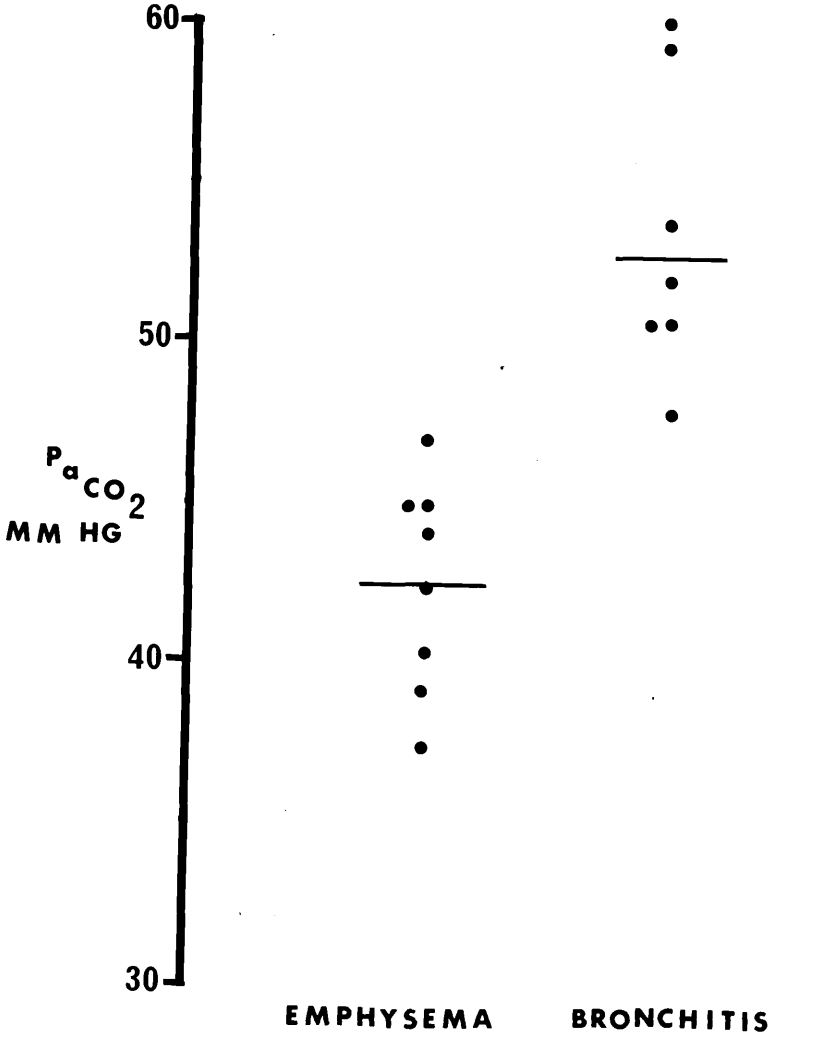

Figure 48. The arterial carbon dioxide tension at rest in 8 patients with emphysema and 7 patients with bronchitis. The mean value is shown by a horizontal bar in each group.

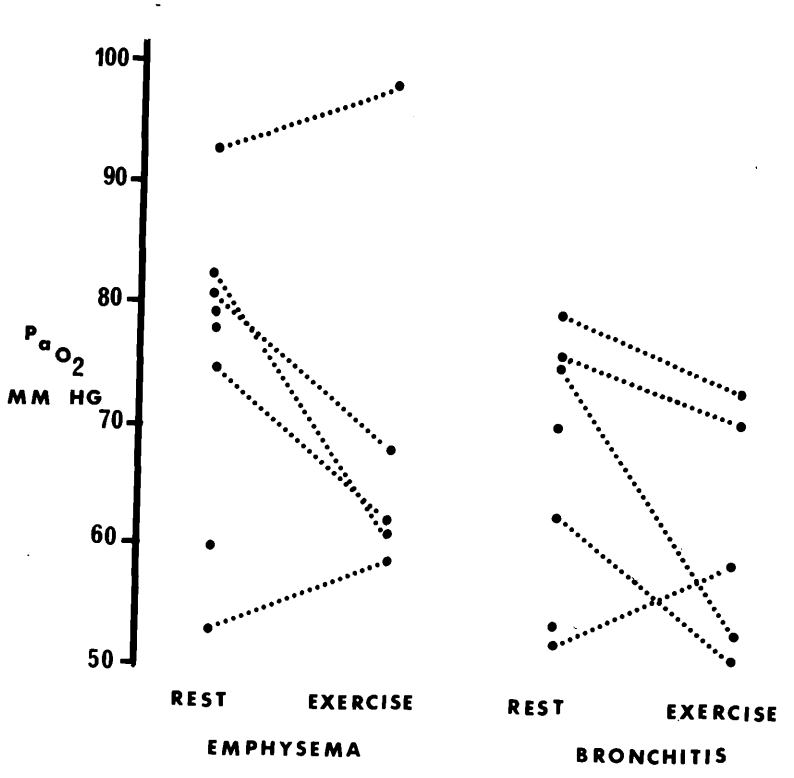

Figure 49 The arterial oxygen tension at rest and after exercise in 8 patients with emphysema and 7 patients with bronchitis. Some of the patients were unable to do any exercise. In them only the resting values are shown. The horizontal bar shows the mean value in each group.

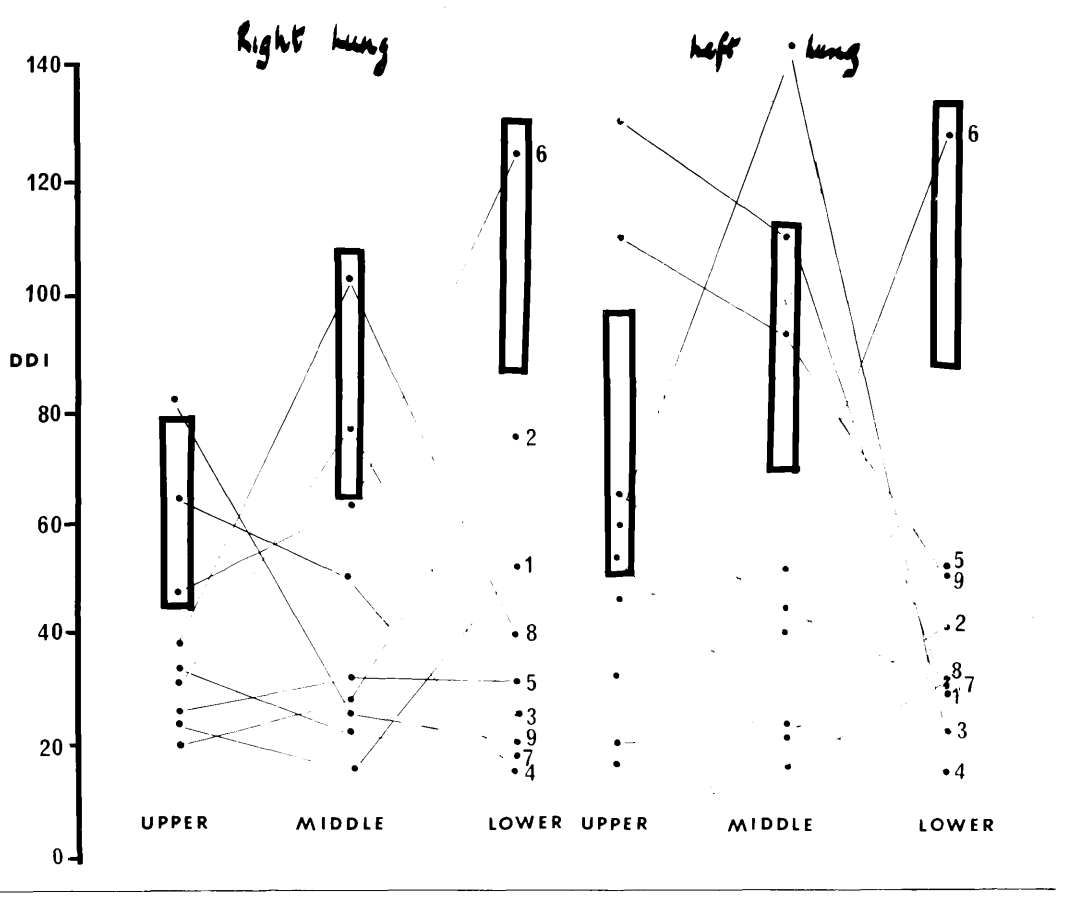

Figure 50. The dynamic distribution indices in the upper, middle and lower zones of both lungs in 9 patients with emphysema. The rectangular blocks indicate the range of normal values. The numbers 1-9 refer to individual patients so that the values in the left and right lungs can be compared in each case. Radiologically there were small mid-lung vessels and vascular loss in the upper and middle zones of patient no. 1, 2, 5 and 6. These changes were only in the lower zones of patient no. 3 and 4. Nos. 7, 8 and 9 had no normal peripheral vessels visible on a chest radiograph.

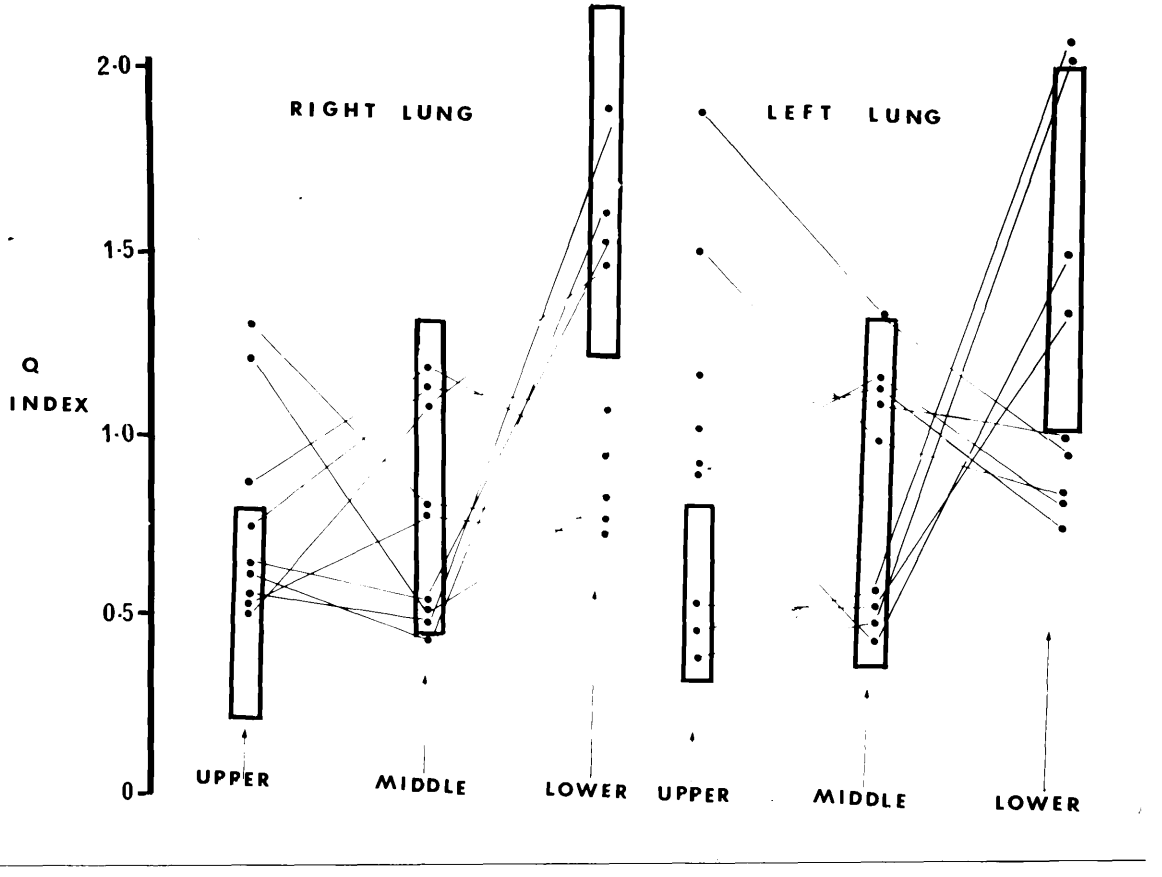

Figure 51. The perfusion indices in 9 patients with emphysema in the upper, middle and lower zones of each lung. The rectangular blocks indicate the range of normal values in these zones.

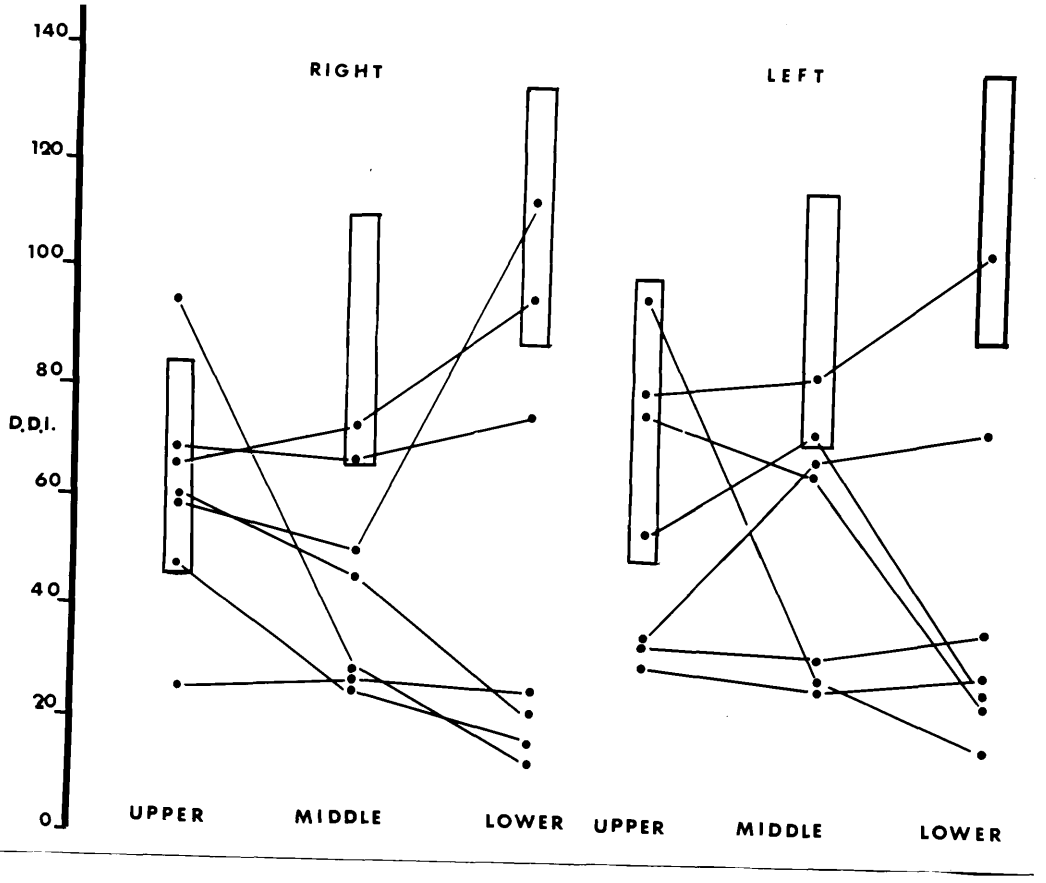

Figure 52. The dynamic distribution indices in the upper, middle and lower zones of both lungs in 7 patients with bronchitis. The rectangular blocks indicate the range of normal values in these zones.

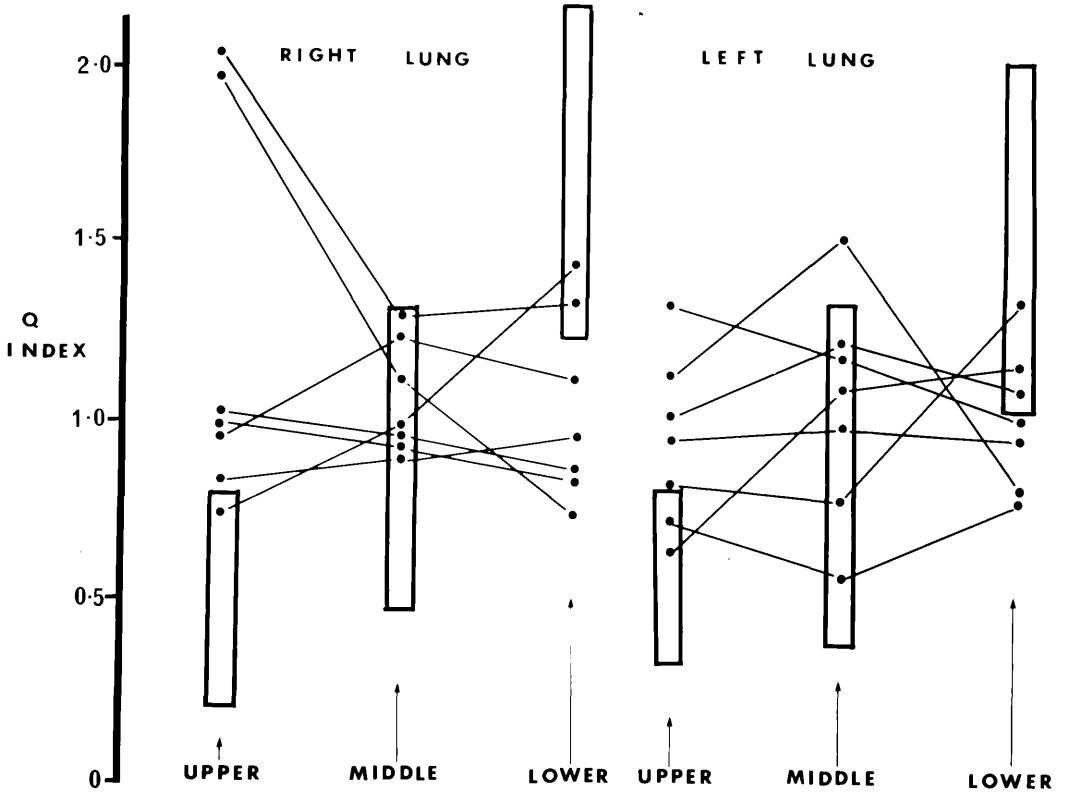

Figure 53. The perfusion indices in 7 patients with bronchitis in the upper, middle and lower zones of each lung. The rectangular blocks indicate the range of normal values in these zones.

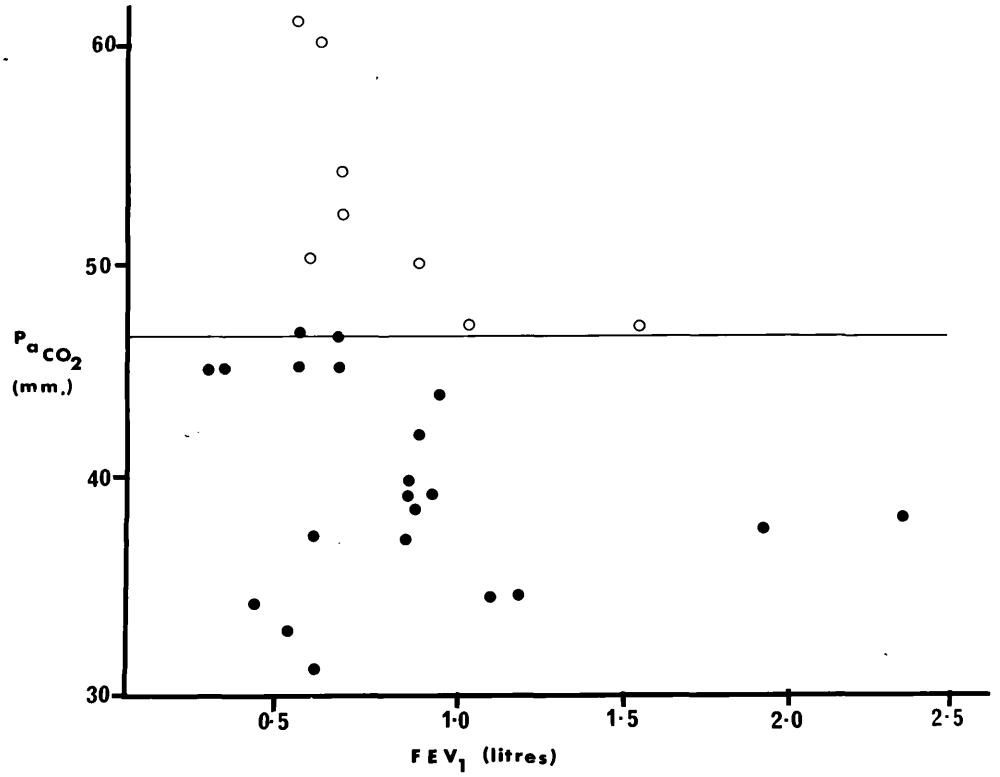

Figure 54. The arterial carbon dioxide tension ($PaCO_2$) in mm.Hg. and the forced expired volume in one second in 8 patients with chronic obstructive bronchitis (Group II) and patients from Group I with no chronic bronchitis. The empty circles are the former group and the solid dots the latter.

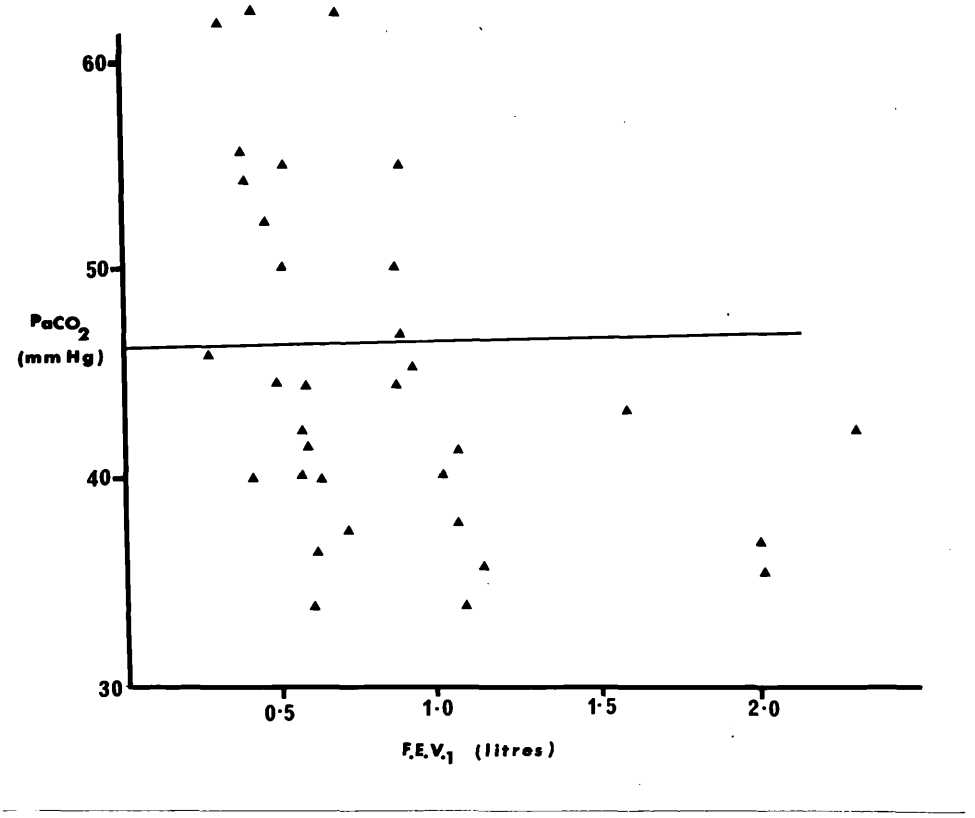

Figure 55. The arterial carbon dioxide tension ($Paco_2$) and the forced expired volume in one second in patients from Group I who have bronchitis in addition to emphysema. The straight line depicts the upper limit of the normal range of $Paco_2$ in this laboratory.

T A B L E XIX.

Clinical pre-operative assessment and subjective change after surgery in patients in Group Ia.

Patient	Age	Sex	± C.B.*	ECG findings*	Grade Of Breathlessness		Subjective Improvement
					Before Op	After Op.	
R.K.	56	M	+	Normal	V	II	3
A.S.	60	M	+	Normal	V	II	3
E.Sh.	64	M	-	Normal	IV	II	2
W.Sh.	59	M	-	RV+	V	III	2
W.P.	44	F	-	Normal	V	III	2
J.W.	55	M	-	RV+	V	III	2
Gl.H.	55	F	-	Normal	V	II	3
					II	II	0
A.V.M.	63	M	-	Normal	IV	III	1
T.P.	44	M	+	Normal	IV	III	1
H.B.	50	M	+	Normal	V	IV	1
E.Pl.	55	F	-	RV+	V	V	0
Geo. H.	53	M	-	RV+	II	II	0
R.H.	49	M	+	Normal	V	V	0
J.E.	39	M	+	RV+	III	III	0

* C.B. = Chronic Bronchitis, + = present; - = absent.

+RV+ = Right ventricular hypertrophy according to the criteria of Towers (1966).

TABLE XX.

Radiological findings and localisation with ^{133}Xe before operation with subjective imporvement after surgery in Group I patients.

Patient	Rad.+ Diagnosis	Compression	Site and Size Demarcated Bullae	Radiologically Hypovascular Zones*	Zones with Low D.D.I.*	Subjective Improvement
R.K.	Gen.	-	-	All Except LU	Mids and Lowers.	3
A.S.	Loc.	+	RL 15x15cms.	Lowers	All Except LU	3
E.Sh.	Gen.	-	RL 15x12cms LL 7x7 cms.	Uppers R.M. & Lowers	R.M. and Lowers	2
W.Sh.	Gen.	-	-	All Except LU	R.M. and Lowers	2
W.P.	Loc.	-	RL 8x8 cms.	R.M. & Lowers	All Except RU	2
J.W.	Gen.	-	-	All Except LU	All Except LU	2
Gl.H.	Gen.	-	-	Uppers & Mids Uppers & Mids	All Zones R.Lung Only	3 0
A.V.M.	Loc.	-	R.L. 9x9cms	Lowers	R.U. and Lowers	1
T.P.	Loc.	-	LL 15x15cms	Left Lower	L.M. and Lowers	1
H.B.	Normal	-	-	None	Mids and Lowers	1
E.Pl.	Loc.	-	-	Uppers & Mids	All Zones	0
Geo.H.	Loc.	+	LL 18x18cms.	Uppers & L. Lower	L. Upper& Lowers.	0
R.H.	Gen.	+	-	L.M. and Lowers	Middles & Lowers	0
J.E.	Loc.	-	-	Lowers	L.U. L.M.& Lowers	0

\+ In this column Gen. - generalised. Loc. - Localised emphysema.

* L.U. - Left Upper Zone. R.U. - Right Upper Zone.
L.M. - Left Middle Zone. R.M. - Right Middle Zone.

TABLE XXI.

Vital Capacity and Forced Expired Volume in 1 Second before operation and the change in these values after operation in Patients in Group Ia.

Patient	V.C.*(l.) before operation	Change in V.C. after operation(ml)	$\frac{FEV_1}{FVC}$ % Before Op.	Change in FEV_1 after operation(ml.)
R.K.	3·60 (89)	+0·30	$\frac{600}{2400}$ 25%	nil
A.S.	2·20 (59)	+0·30	$\frac{500}{1670}$ 30%	+ 100
E.Sh.	2·40 (55)	+1·30	$\frac{900}{2090}$ 43%	+ 400
W.Sh.	3·25 (74)	+1·20	$\frac{1000}{3000}$ 33%	+ 100
W.P.	2·40 (60)	+0·20	$\frac{600}{1500}$ 40%	nil
J.W.	1·80 (41)	+0·40	$\frac{500}{1800}$ 28%	nil
Gl.H.	1·40 (50)	+0·70	$\frac{300}{1000}$ 30%	+ 200
	2·10 (14)	+0·05	$\frac{500}{2280}$ 22%	- 100
T.P.	3·20 (60)	+0·10	$\frac{900}{2700}$ 33%	- 150
A.V.M.	4·40 (100)	-0·80	$\frac{900}{2400}$ 38%	+ 300
H.B.	2·90 (72)	+0·10	$\frac{600}{2400}$ 25%	+ 200
E.Pl.	1·20 (51)	-0·05	$\frac{250}{1100}$ 23%	+ 50
Geo. H.	3·40 (92)	-0·30	$\frac{800}{3300}$ 24%	-200
R.H.	2·15 (53)	+0·15	$\frac{1050}{2500}$ 42%	-650
J.E.	3·80 (72)	-0·05	$\frac{1050}{3600}$ 29%	+150

* % of the predicted value is shown in parenthesis.

Figure 56. Lateral chest tomograph taken 7 cms. from the table on the left side of R.K. before operation.

Figure 57. Lateral chest tomograph taken 7 cms. from the table on the left side of R.K. after operation. Note difference in vessels behind heart.

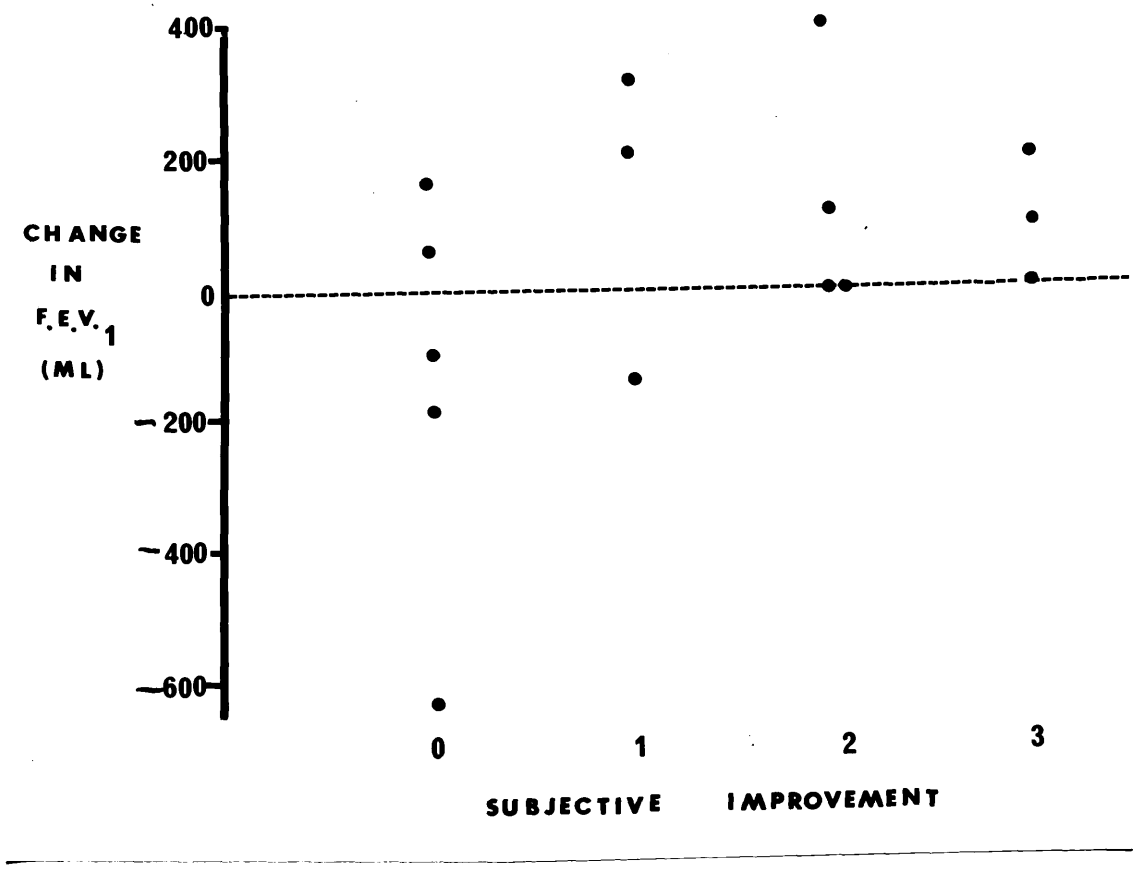

Figure 58. A comparison between the change in the $F.E.V._1$ and subjective improvement after thoracotomy in 15 patients with emphysema (Group Ia). The subjective improvement is judged by the change in the grade of breathlessness.

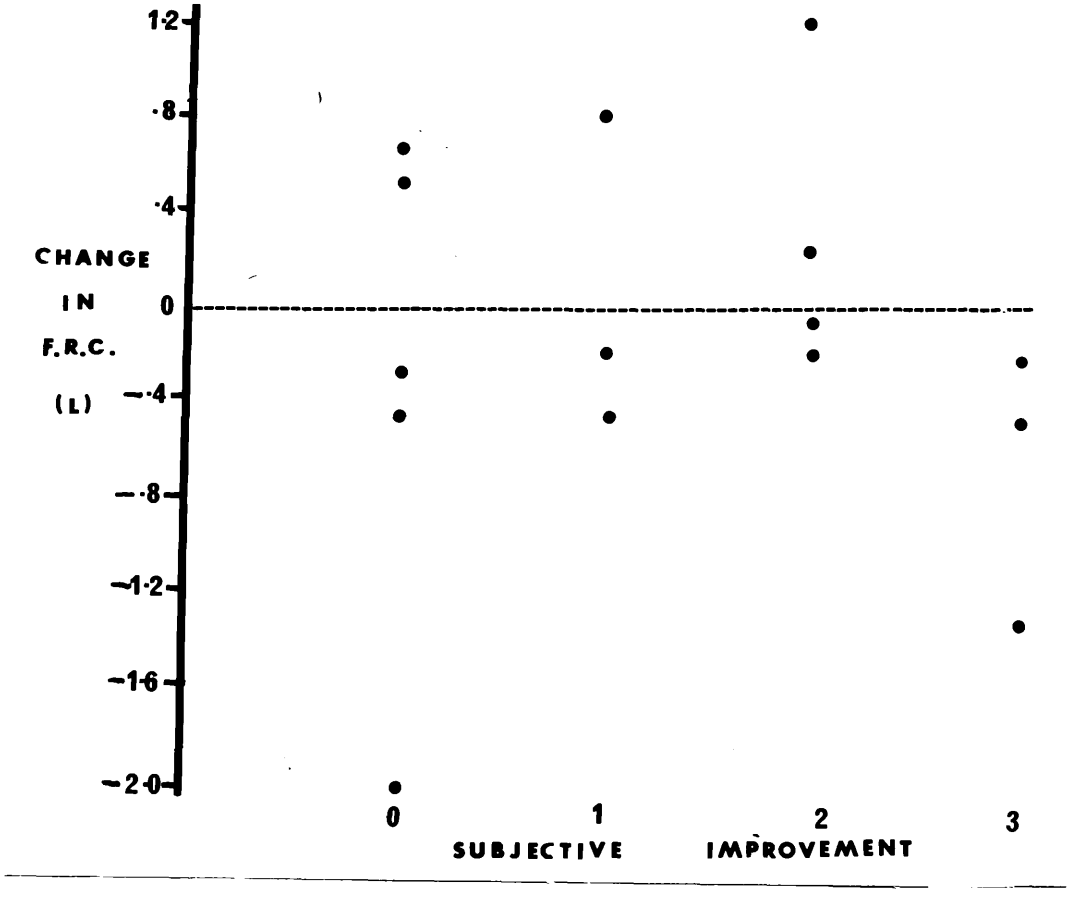

Figure 39. A comparison between the change in the F.R.C. and subjective improvement after thoracotomy in 15 patients with emphysema (Group Ia).

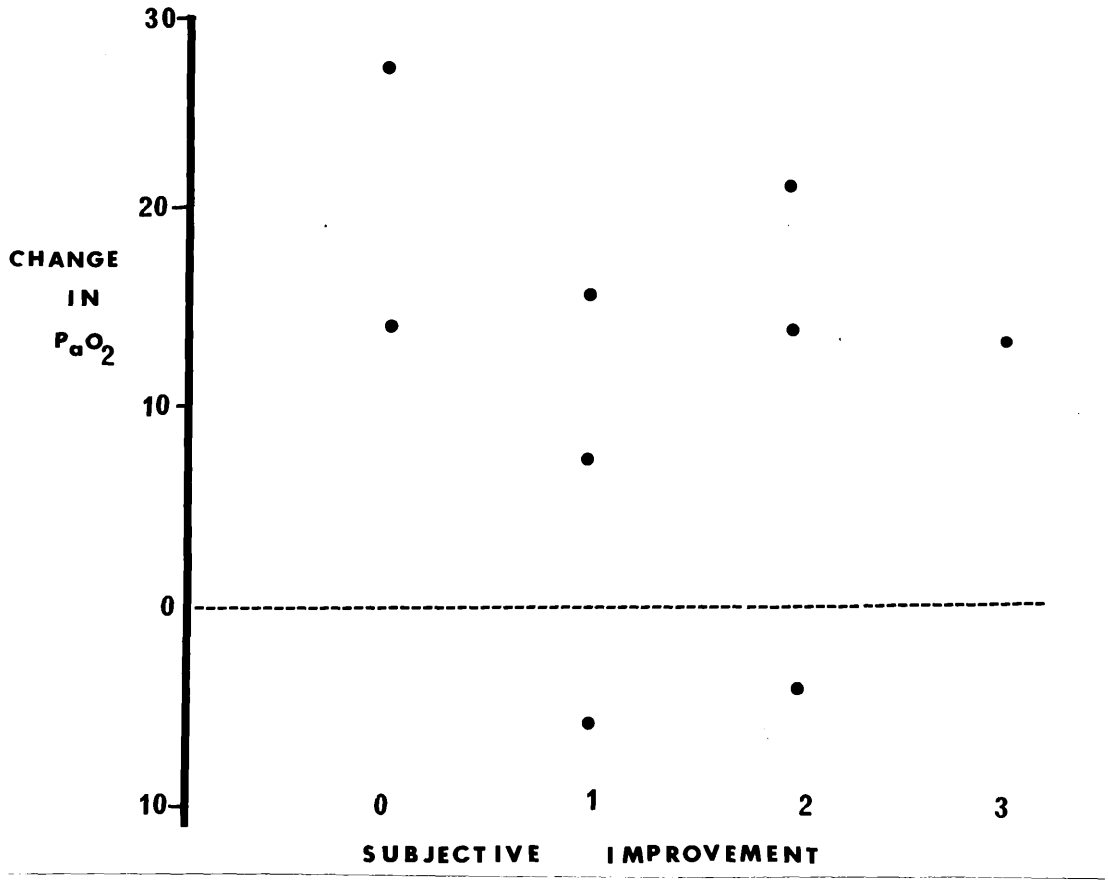

Figure 60. The relationship between the change in resting arterial oxygen tension ($Pa0_2$) after thoracotomy and the subjective improvement in 9 patients with emphysema from Group Ia.

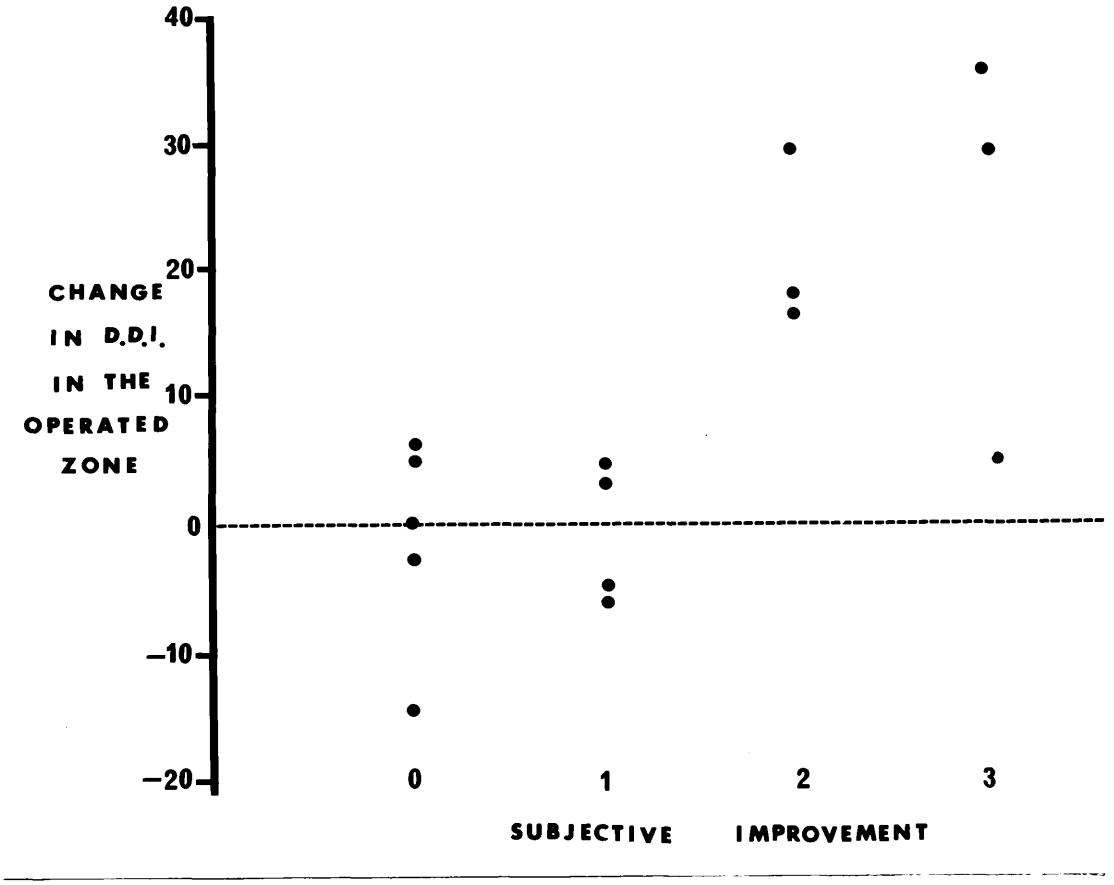

Figure 61. A comparison between the change in the D.D.I. in the operated zone and the subjective improvement after thoracotomy in 15 patients with emphysema (Group Ia).

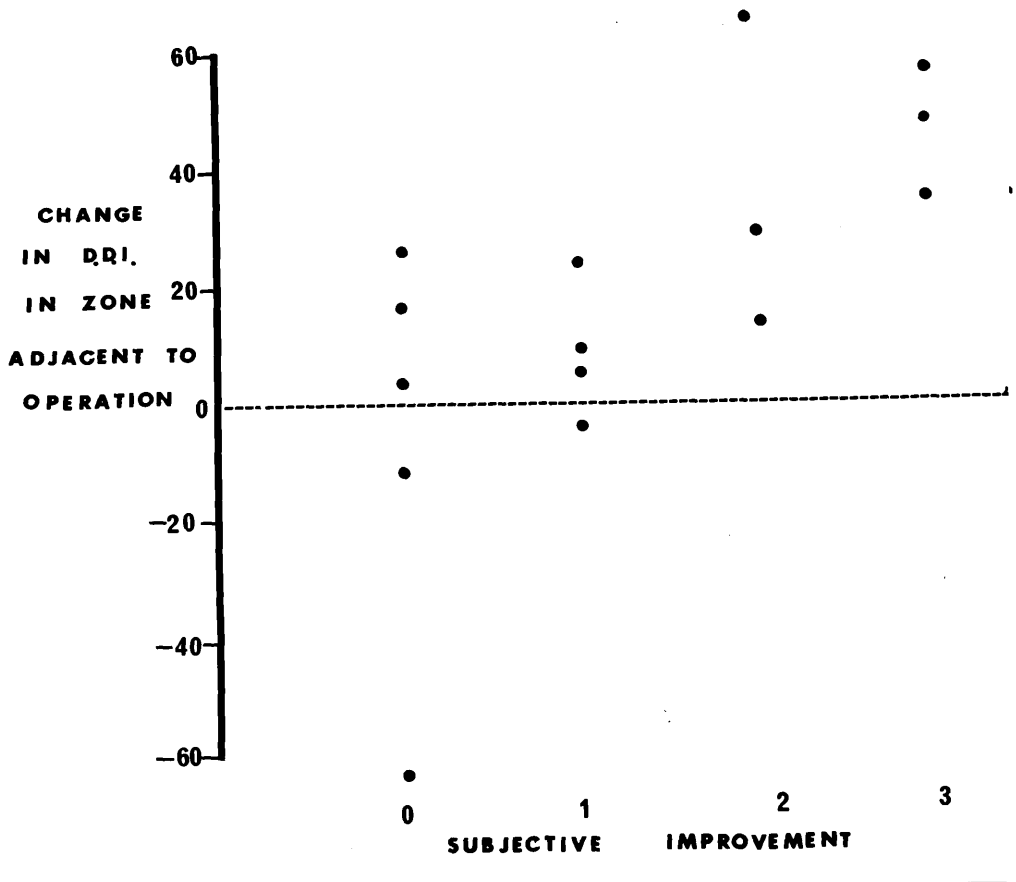

Figure 62. A comparison between the change in the D.D.I. in the zone adjacent to that mainly operated upon and the subjective improvement after thoracotomy in 15 patients with emphysema (Group Ia).

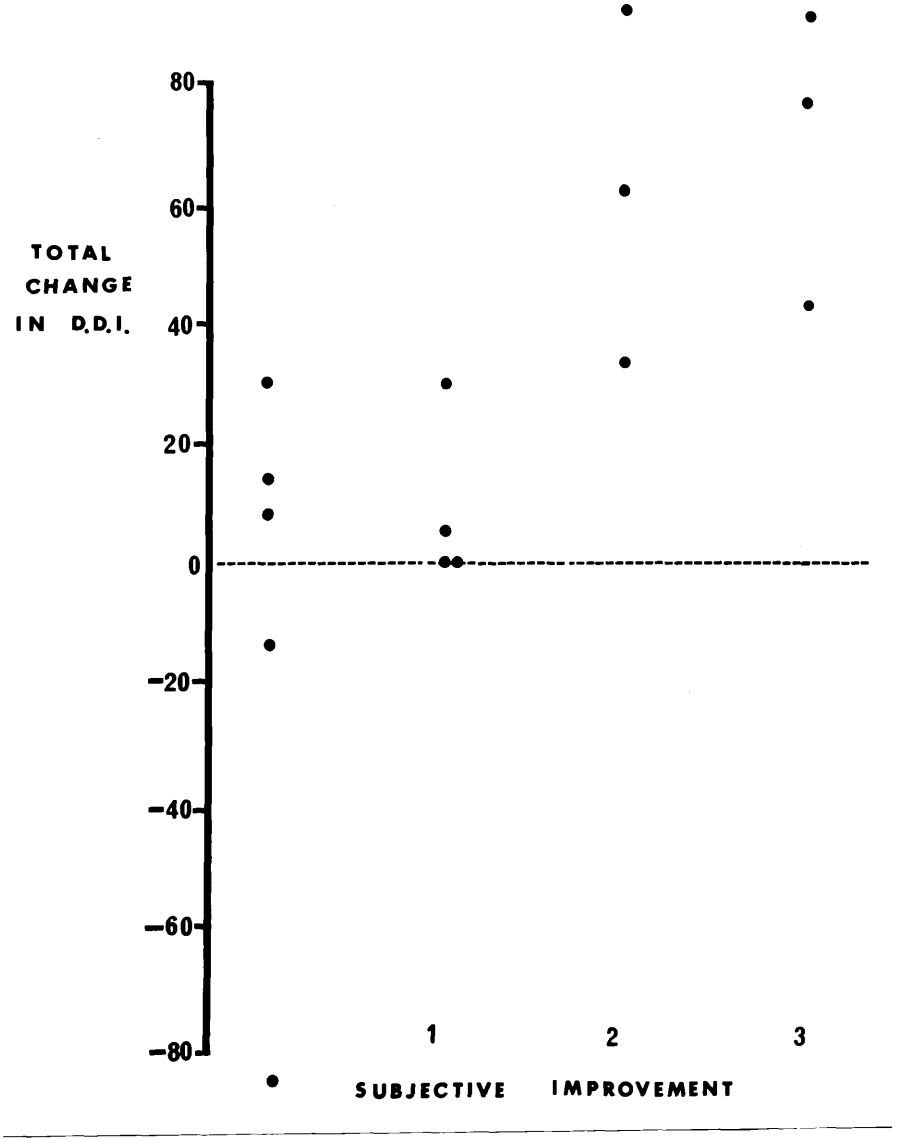

Figure 63. A comparison between the sum of the changes in the D.D.I. in the operated and the adjacent zone ("Total D.D.I.") and the subjective improvement after thoracotomy in 15 patients with emphysema (Group Ia).

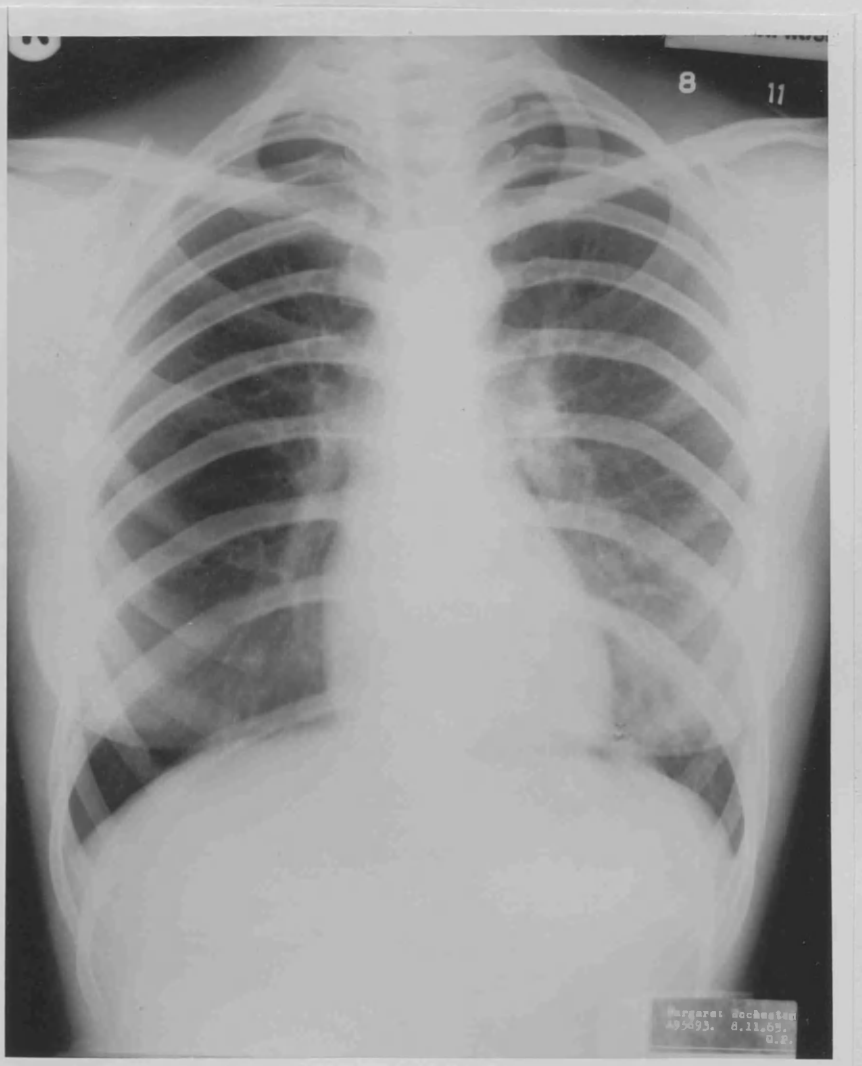

Figure 64. Postero anterior chest radiograph of patient (M.E.) with unilateral transradiancy. The right lung is transradiant. Note also the smaller pulmonary artery on that side.

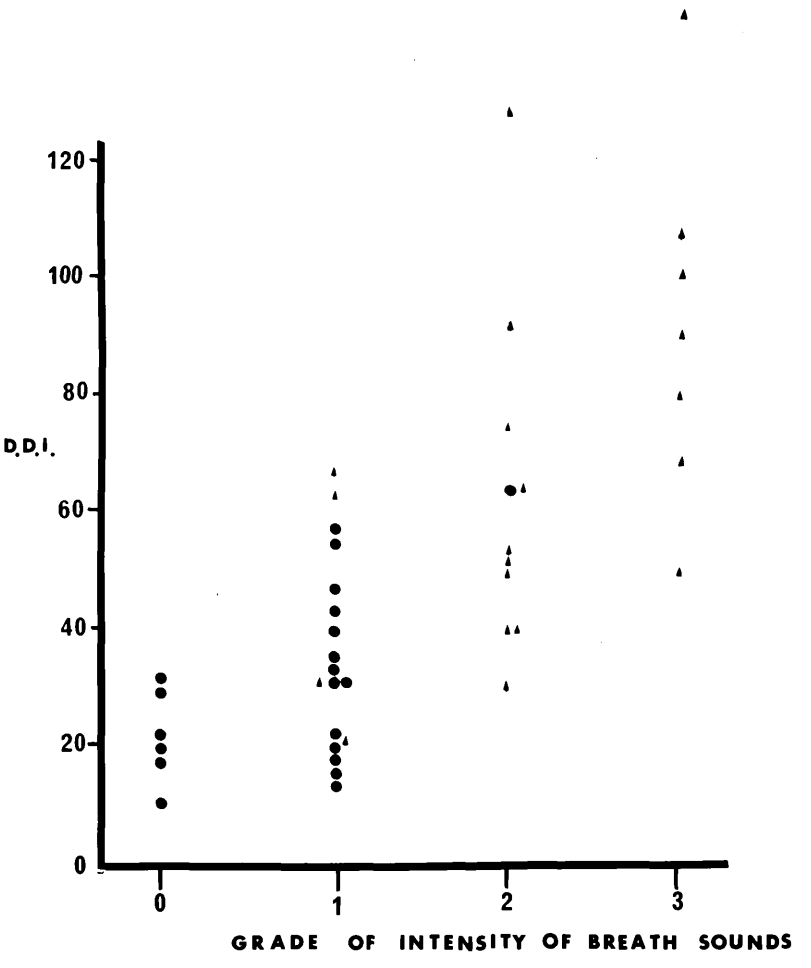

Figure 65. This shows the relationship between the grade of intensity of the breath sounds and the D.D.I. in 7 patients with unilateral transradiancy (Group III). The circles are breath sounds heard in the transradiant lung and the smaller triangles are breath sounds heard in the contralateral lung.

TABLE XXII.

Grading of Symptoms in 7 Patients with Macleod's Syndrome, (Group III).

Patient (Age & Sex)	Cough	Sputum	History (Recent)	Breathlessness	History of Childhood Illness.
M.E. (18;F.)	2	0	1	1	"Born with Bronchitis"
A.K. (46;M.)	0	0	2	3	Serious Chest Illness, aet. 9/12
A.S. (53;M.)	2	2	2	3	Cough Since age of 2 years.
E.L. (47;M.)	2	2	2	4	Double pneumonia & bronchitis as baby
D.C. (41;M.)	2	2	2	3	Double pneumonia aet. 8 years.
M.D. (28;M.)	1	1	2	2	Pneumonia, aet.2 years
H.S. (54;F.)	1	1	0	5	Pneumonia and pleurisy when "very young".

T A B L E XXIII

Lung volumes, flow rates and airway conductance measurements in 7 patients with Macleod's Syndrome (Group III). The predicted values are shown beneath the observed values in brackets.

Patient	F.R.C. litres	RV/TLC	V.C. litres	$\frac{FEV_1}{FVC}$ ml.	Airway Conductance (C) and Lung Vol.(V) at which it was measured	
					C (litres/sec/cm H_2O)	V.litres
M.E.	2·18 (2·67)	41% (26%)	2·60 (3·60)	$\frac{1800}{2600}$ 69%	0·260 (0·263)	2·01
A.K.	4·03 (3·48)	55% (33%)	3·10 (4·05)	$\frac{1000}{2600}$ 38%	0·121 (1·001)	7·65
A.S.	4·90 (3·74)	48% (33%)	3·50 (4·36)	$\frac{900}{2900}$ 31%	0·267 (0·770)	5·92
E.L.	4·28 (2·98)	60% (34%)	2·40 (3·40)	$\frac{650}{2050}$ 32%	0·235 (0·780)	6·32
D.C.	4·81 (4·25)	54% (31%)	3·50 (5·30)	$\frac{1000}{2500}$ 40%	0·192 (1·050)	8·10
M.D.	4·32 (3·99)	54% (28%)	2·80 (5·28)	$\frac{900}{2450}$ 37%	0·105 (0·690)	5·30
H.S.	2·12 (2·90)	44% (34%)	2·05 (3·22)	$\frac{1200}{1800}$ 67%	0·247 (0·314)	2·42

T A B L E XXIV.

The diffusing capacity for carbon monoxide (D_{LCO}) and the minute ventilation (Vent.) at rest and during exercise with the percentage extraction of CO (% Extr.) at rest in 7 patients with Macleod's Syndrome (Group III). The predicted values are shown beneath the observed values in brackets.

Patient	D_{LCO} at rest	Vent. l/min.	% Extr.	D_{LCO} Exercise	Vent. l/min.
M.E.	17·7 (21·9)	11·0	49 (55)	17·9 (25·0)	15
A.K.	9·4 (15·5)	13·0	30 (40)	15·2 (28·0)	21·6
A.S.	8·9 (16·9)	8·7	37 (40)	12·0 (29·0)	19·0
E.L.	10·4 (19·3)	7·0	44 (46)	13·2 (30·0)	15·4
D.C.	9·1 (20·0)	10·1	39 (46)	27·8 (35·0)	27·6
M.D.	20·9 (23·2)	10·4	48 (53)	22·4 (45·0)	20·9
H.S.	9·8 (14·6)	11·3	33 (44)	13·4 (28·0)	23·8

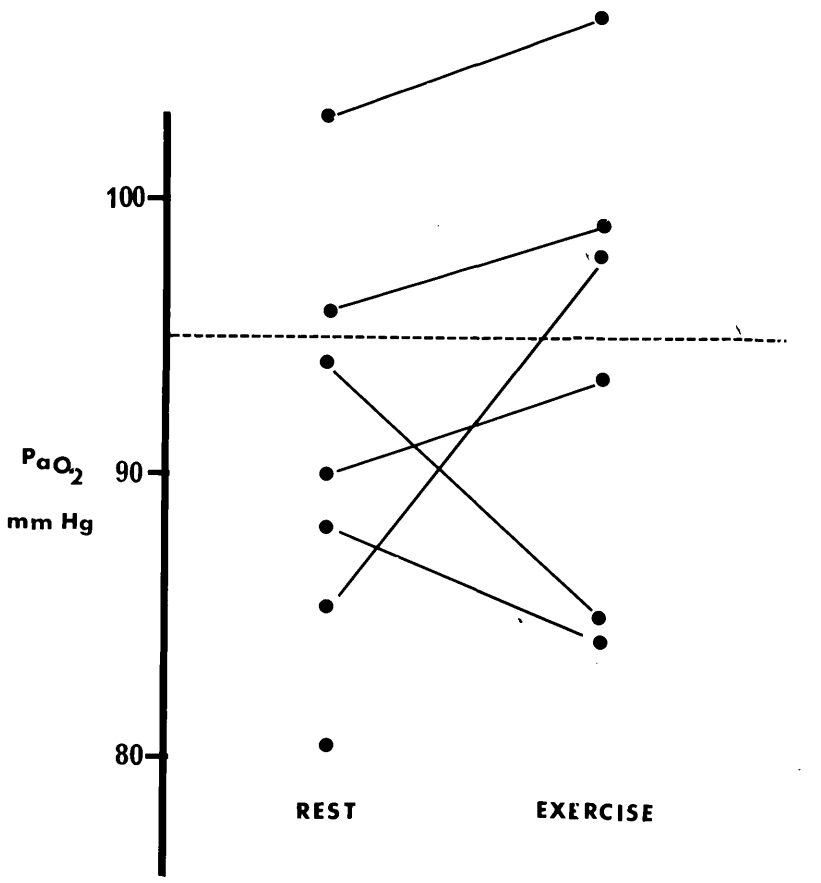

Figure 66 . The partial pressure of oxygen in the arterial blood at rest and after exercise in 7 patients with unilateral transradiancy (Group III). The dashed line at the level of 95 mm.Hg. represents the normal mean value.

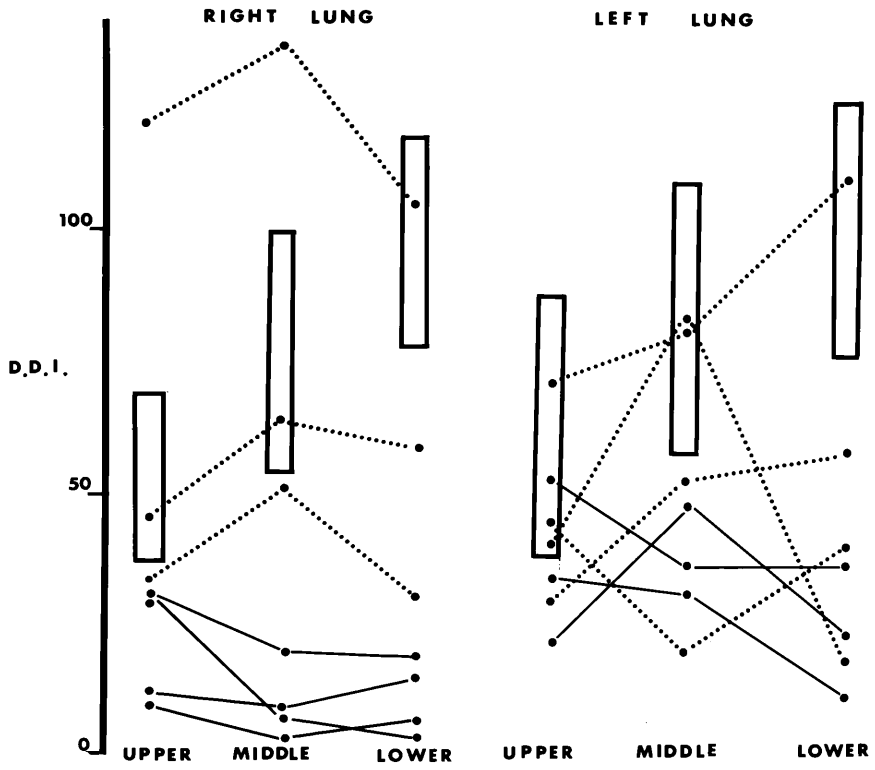

Figure 67. The dynamic distribution indices in the upper, middle and lower zones of the lungs in 7 patients with unilateral transradiancy (Group III). The rectangular blocks show the range of normal values. Points connected by a solid line are observations from the transradiant lung whereas points connected by a dotted line are observations from the contralateral or better lung.

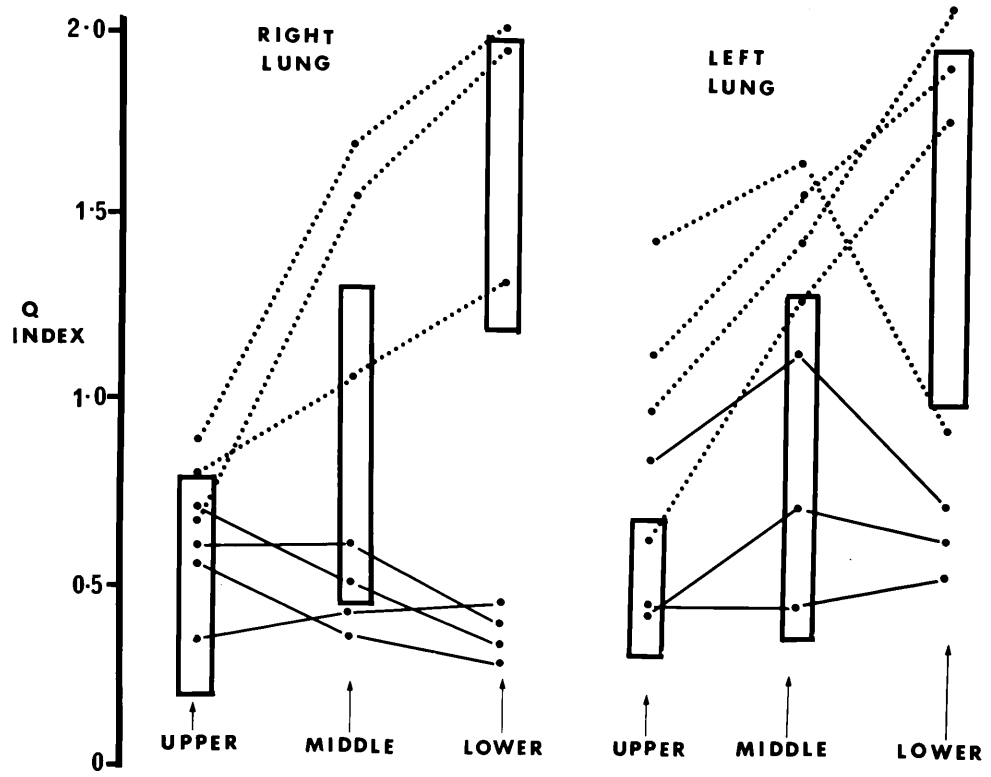

Figure 68. The perfusion indices in the upper, middle and lower zones of the lungs in 7 patients with unilateral transradiancy (Group III). The rectangular blocks show the range of normal values in each zone. Points connected by a solid line are observations from the transradiant lung, whereas points connected by a dotted line are observations from the contralateral or better lung.

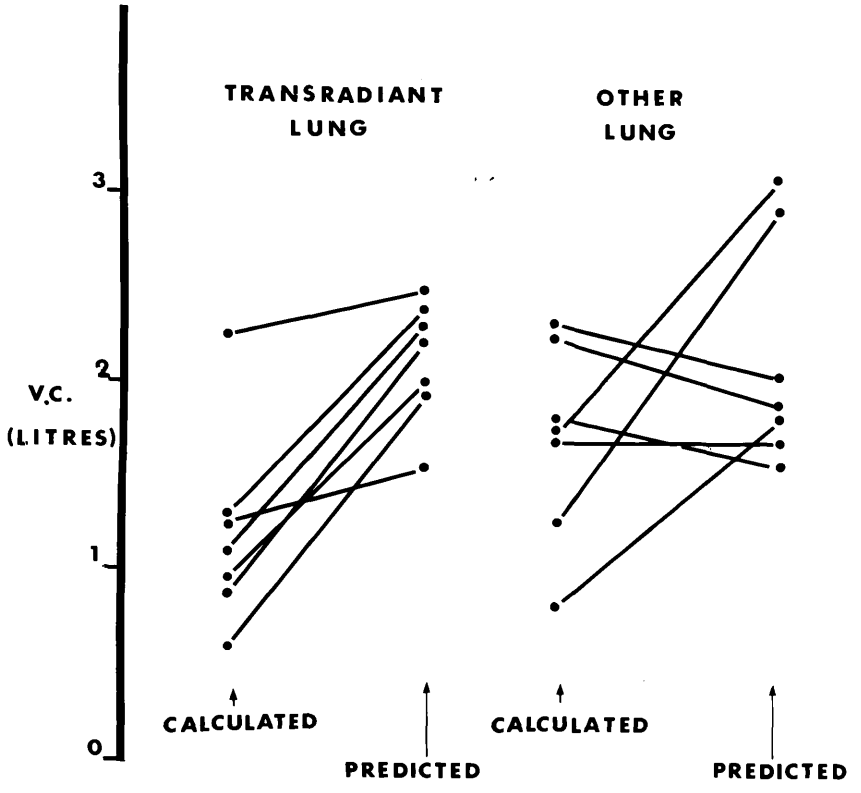

Figure 69. Calculated and predicted values for the vital capacity of the transradiant and other remaining lung in 7 patients with unilateral transradiancy (Group III). The predicted value for each lung is calculated from the total predicted vital capacity and Svanberg's (1957) data. The observed vital capacity for both lungs is apportioned according to the sum of the counting rates in each lung after maximal inspiration.

TABLE XXV.

The calculated distribution of the observed vital capacity of 7 patients exhibiting Macleod's syndrome (Group III). The normal partition of the predicted vital capacities are shown for comparison.

Patient	Side Affected	Vital Capacity l.			
		Transradiant Lung		Better Lung	
		Calculated	Predicted	Calculated	Predicted
M.E.	Right	0·94	1·94	1·66	1·66
A.K.	Right	0·84	2·19	2·23	1·86
A.S.	Right	1·23	2·35	2·27	2·01
E.L.	Right	0·62	1·89	1·78	1·61
D.C.	Left	2·21	2·44	1·29	2·86
M.D.	Left	1·10	2·26	1·70	3·02
H.S.	Left	1·23	1·53	0·82	1·79

TABLE XXVI.

The observed lung volumes and conductances measured at the same time in 7 patients exhibiting Macleod's syndrome (Group III). The volume of the contralateral lung is calculated from the total observed lung volume according to the sum of the counts in each lung at equilibrium. The predicted conductances are calculated from the lung volumes according to Briscoe and Dubois, (1958).

Patient	Side Affected	Observed Lung Volume (l.)	Observed total conductance (l/sec./cm. water).	Predicted total conductance (l/sec/cm. water).	Calculated volume of contralateral lung (l).	Predicted conductance of contralateral lung (l/sec/cm water).
M.E.	Right	2·01	0·260	0·263	1·00	0·130
A.K.	Right	7·65	0·121	1·001	4·16	0·540
A.S.	Right	5·92	0·267	0·770	3·15	0·410
E.L.	Right	6·32	0·235	0·780	3·46	0·450
D.C.	Left	8·10	0·192	1·050	4·73	0·615
M.D.	Left	5·30	0·105	0·690	2·70	0·350
H.S.	Left	2·42	0·247	0·314	1·26	0·150

Questionnaire on Respiratory Symptoms

COUGH	Yes	No
1. Do you usually cough first thing in the morning in winter?		
2. Do you do this in summer?		
3. Do you usually cough during the day or at night in winter?		
4. Do you do this in summer?		
5. Do you cough like this on most days for as much as 3 months each year? (If "yes" to questions 1-4).		
PHLEGM		
6. Do you usually bring up any phlegm from your chest first thing in the morning in winter?		
7. Do you do this in summer?		
8. Do you bring up any phlegm from your chest during the day or at night in winter?		
9. Do you do this in summer?		
10. Do you bring up phlegm like this on most days for as much as 3 months each year? (If "yes" to any of questions 6-9).		
11. How long have you had this phlegm? Is it less than 2 years or more than 2 years?		
BREATHLESSNESS		
12. Are you ever troubled by shortness of breath, when hurrying on the level or walking up a slight hill?		
13. Do you get short of breath walking with other people at an ordinary pace on the level?		

	Yes	No
14. Do you have to stop for breath when walking at your own pace on the level?		
15. Are you short of breath on washing or dressing?		

WHEEZING

	Yes	No
16. Does your chest ever sound wheezy or whistling?		
17. Do you get this with colds?		
18. Do you get this apart from colds?		
19. Do you get this most days or nights?		

CHEST ILLNESSES

20. During the past 3 years have you had any chest illness which has kept you off work, indoors, at home or in bed?

21. If "yes", ask details of each illness:-

Year	Duration of Incapacity		Increased Phlegm		Doctor's diagnosis
	One week or more	Less than one week	Yes	No	

OPERATIONS:

	Yes	No
22. Do you smoke?		
23. Have you ever smoked?		

a) No. of cigarettes per day .....
b) Time of stopping smoking .....

PREVIOUS HISTORY

a. How old were you when you first began to bring up phlegm most days in winter? Age .....

b. Did this come on gradually? Yes / No

c. Did this come on after an illness? Yes / No

d. Did this come on in some other way? Yes / No
If "yes" to c. or d. describe .....

.....

Onset of breathlessness:

e. How old were you when you first noticed shortness of breath? Age .....

f. Did this come on gradually? Yes / No

g. Did this come on after an illness? Yes / No

h. Did this come on in some other way? Yes / No
If "yes" to g. or h. describe .....

.....

i. Did you have any cough or phlegm at all before you first became breathless? Yes / No

j. If "no", ask: Not even a smoker's cough? Yes / No

k. If "yes" to j: Did you bring up any phlegm with this cough? Yes / No

System of Grading.

Cough	Grade 0	"No" to questions 1-4 (incl.)
	Grade 1	"Yes" to questions 1 or 2 and 5
	Grade 2	"Yes" to questions 1-5 (incl.)
Phlegm	Grade 0	"No" to questions 6-10 (incl.)
	Grade 1	"Yes" to questions 6 or 7 and 10
	Grade 2	"Yes" to questions 6-10 (incl.)

For Cough and Phlegm grades 1 and 2 also required the answer "yes" to question 11.

Breathlessness

Grade 1	"No" to question 12-15 (incl.)
Grade 2	"Yes" to question 12
Grade 3	"Yes" to questions 12 and 13
Grade 4	"Yes" to questions 12-14 (incl.)
Grade 5	"Yes" to questions 12-15 (incl.)

Chest Illnesses

Grade 0	"No" to question 20
Grade 1	"Yes" to question 20 and history of one illness with increased phlegm with 1 weeks incapacity.
Grade 2	"Yes" to question 20 and history of two or more illnesses with increased phlegm with 1 weeks incapacity.

Smoking

Non-smoker	-	never smoked at any time
Ex-smoker	-	stopped smoking 3 months
Light smoker	-	(0-14) cigarettes per day
Moderate smoker	-	(15-24) cigarettes per day
Heavy smoker	-	24 cigarettes per day

A P P E N D I X II.

Tables Of

Physical Characteristics and Symptomatology

Radiological Observations

$F.E.V._1$, Static Lung Volumes and D_LCO

Arterial Blood Gases

Regional Ventilation and Perfusion Data

Physical Characteristics and Symptomatology in Patients in Group I.

Patient	Sex	Age (yrs)	Ht. (ins)	Wt. (lbs.)	Grade B	Grade C/S	Chest Illness	Smoking	Chest Ops	Age Onset B	First Symptoms.
F.B.	Male	57	70	133	3	2/2	0	Light	0	50	B
R.K.	Male	56	68	120	5	1/1	0	Mod.	1	50	C.S.
E.St.	Male	62	68	126	5	1/1	0	Ex.Light	0	55	B
G.B.	Male	57	72	168	5	2/2	1	Non	1	44	C.S.
H.B.	Male	50	68	140	5	1/1	2	Ex.Mod	1	43	B
J.E.	Male	39	73	131	3	2/2	2	Ex.Heavy	1	34	B
R.G.	Male	46	64·5	120	3	2/1	1	Heavy	0	46	C.S.
S.G.	Male	58	67	118	5	1/1	2	Mod.	0	42	C.S.
R.H.	Male	49	67	143	5	2/2	2	Ex.Light	1	41	C.S.
T.J.	Male	60	70·5	108	5	1/1	2	Ex.Mod	2	45	C.S.

Ht. - Height (inches)
Wt. - Weight (lbs.)
B - Breathlessness

C - Cough
S.- Sputum
Ops.- Operations

Light - $<$ 15 cigarettes per day
Mod - 15-24 cigarettes per day
Heavy - $>$ 24 cigarettes per day

Physical Characteristics and Symptomatology in Patients in Group I.*

Patient	Sex	Age (yrs)	Ht. (ins)	Wt. (lbs)	Grade B	Grade C/S	Chest Illness	Smoking	Chest Ops.	Age Onset B	First Symptoms.
T.F.	Male	52	66	133	5	2/2	2	Light	0	49	C.S.
J.M^{c}M	Male	44	73	133	5	2/2	2	Mod.	1	40	C.S.
W.M^{c}D	Male	65	67·5	155	5	1/1	0	Ex.Heavy	0	60	C.S.
C.M.	Male	53	73	138	5	2/1	2	Ex.Light	0	43	C.S.
T.P.	Male	44	72	140	4	2/2	2	Ex.Mod	1	37	C.S.
L.Car	Male	59	67	144	5	1/1	0	Ex.Mod	0	24	B.
A.S.	Male	60	67·5	137	5	1/1	2	Ex.Mod	1	59	C.S.
G.P.	Male	55	71	138	5	1/2	1	Light	0	48	C.S.
W.Sm	Male	70	70·5	120	5	1/1	0	Ex.Mod	0	61	C.S.
J.K.	Male	65	67	124	4	2/2	2	Ex.Heavy	0	60	C.S.

* Key to abbreviations are at beginning of appendix.

Physical Characteristics and Symptomatology in Patients in Group I.

Patient	Sex	Age (yrs)	Ht. (ins)	Wt. (lbs)	Grade B	Grade C/S	Chest Illness	Smoking	Chest Ops.	Age Onset B	First Symptoms
A.H.	Male	61	70	154	4	1/1	0	Ex Heavy	0	60	B
J.Her	Male	62	71	136	5	2/0	2	Ex Light	0	58	C.S.
N.S.	Male	51	70·5	112	5	2/2	1	Light	0	37	B
G.T.	Male	48	65	94	5	2/2	2	Ex Mod	1	33	C.S.B.
A.V.	Male	57	69	142	5	2/1	1	Ex Heavy	0	50	C.S.B.
S.B.	Male	62	67	126	3	2/2	2	Ex Mod	0	60	C.S.B.
C.B.	Male	42	68·5	105	5	2/2	2	Ex Heavy	0	38	B
T.C.	Male	61	74	159	5	2/2	0	Heavy	0	56	C.S.
R.F.	Male	37	70·5	177	5	2/2	2	Ex Heavy	0	32	C.S.
J.Hud	Male	60	68	121	4	2/2	1	Mod	0	59	C.S.

Physical Characteristics and Symptomatology in Patients in Group I.

Patient	Sex	Age (yrs)	Ht. (ins)	Wt. (lbs)	Grade B	Grade C/S	Chest Illness	Smoking	Chest Ops	Age Onset B	First Symptoms
L.Cun	Male	66	67	109	5	2/2	1	Light	0	58	C
D.C.	Male	53	67	109	5	2/1	2	Mod	0	47	C
A.M.	Male	55	68	146	3	0/0	0	Ex Heavy	0	50	C
J.C.	Male	59	72·5	163	3	0/0	0	Mod	0	52	B
G.F.	Male	56	73·5	203	2	0/0	0	Ex Heavy	0	46	B
Gl.H.	Female	55	61	93	5	0/0	0	Mod	2	38	B
A.V.M.	Male	63	72	173	4	0/0	0	Ex Mod	1	50	B
Geo.H.	Male	53	64·5	147	3	0/0	2	Ex Light	1	47	B
E.P.	Female	55	60	92	5	0/0	1	Ex Light	1	40	B
A.P.	Male	40	67	153	5	0/0	0	Ex Mod	1	31	B

Physical Characteristics and Symptomatology in Patients in Group I.

Patient	Sex	Age (yrs)	Ht. (ins)	Wt. (lbs)	Grade B	Grade C/S	Chest Illness	Smoking	Chest Ops	Age Onset B	First Symptoms
W.Sh	Male	59	70	167	5	0/0	2	Ex Light	2	48	B
J.W.	Male	55	71	128	5	0/0	2	Ex Mod	1	45	B
W.P.	Female	44	69	146	5	0/0	0	Ex Light	1	30	B
R.P.	Male	60	74	134	1	0/0	1	Heavy	0	-	-
P.J.	Male	58	73	120	5	0/0	0	Light	0	48	B
H.K.	Male	54	71	176	5	0/0	0	Ex Mod	1	45	B
E.Sh	Male	64	71	140	4	0/0	0	Ex Light	1	59	B
J.S.	Male	54	71	132	2	0/0	0	Ex Heavy	0	52	B
C.Mah	Male	62	72	110	5	0/0	0	Ex Mod	0	42	B
N.H.	Female	42	65	96	4	0/0	0	Ex Heavy	0	29	B

Physical Characteristics and Symptomatology in Patients in Group II.

Patient	Sex	Age (yrs)	Ht. (ins)	Wt. (lbs)	Grade B	Grade C/S	Chest Illnesses	Smoking	Chest Ops.	Age Onset B	First Symptoms
E.N.	Male	60	67	141	5	2/2	2	Ex Mod	-	56	C.S.
L.M.	Male	64	65	158	3	2/2	2	Light	-	62	C.S.
E.G.	Male	53	71•5	180	3	2/2	2	Heavy	-	48	C.S.
F.K.	Male	62	68	126	3	2/2	2	Mod	-	58	C.S.
R.T.	Male	48	68•5	111	5	2/2	2	Ex Heavy	-	37	C.S.
E.Sc	Female	60	61•5	114	5	2/2	2	Non	-	41	C.S.B.
E.P.	Female	51	63	157	5	2/2	2	Mod	-	49	C.S.
F.R.	Male	59	68.5	145	3	2/2	0	Light	-	56	C.S.

KEY TO ABBREVIATIONS IN RADIOLOGICAL TABLES.

Diaphragm Sh - Shape (F-flat, C-curved).
Ll - Level (no. of anterior ribs).
Move L/R- Movement of left and right hemidiaphragms (cms.).

RsS - Retrosternal space.
Dp - depth (cms.)
D.E. - downward extension (cms.)

T.C./T.H. - Transcardiac and transhilar diameters.

P.A. - Pulmonary artery
H.A. - Hilar artery
} dilated (dil) or normal (N)

Comp. - Compression
fiss. - fissure displacement
V.Cr. - vessel crowding
* N - Normal size vessels, no vessel loss.
- Small size vessels, vessel loss.
+ - Dilated vessels
Shown in Zones.

Dem. Bullae - Demarcated bullae lobe and diameters (cms.)

Rad. Diagnosis- Gen. - Generalised emphysema
Ext.loc. - Extensive localised emphysema.
Loc. - Localised emphysema.

a - before operation.

b - after operation.

Radiological Observations and Measurements in Patients in Group I.

Patient	DIAPHRAGM Sh./Ll	Move L/R	RsS. Dp/D.E.	T.C/T.H. diameter	PA/HA	Comp. fiss/V.Cr	Mid Lung* Vessels	Vessel* loss	Dem. Bullae	Rad. Diagnosis
F.B.	C.7.	$^{0}/1\cdot0$	$4\cdot0/7\cdot0$	$11\cdot0/9\cdot5$	dil/N	nil	= = / N N	= = / N N	nil	Ext. loc.
R.K. a)	F.7.	$1\cdot0/1\cdot0$	$2\cdot0/7\cdot0$	$10\cdot0/10\cdot0$	dil/N	nil	N = / = =	N = / = =	nil	Gen.
b)	F.7.	$2\cdot0/3\cdot5$	$2\cdot0/7\cdot0$	$11\cdot0/10\cdot5$	dil/N	nil	N = / = N	N = / = N	nil	Gen.
E.St.	LF $6\frac{1}{2}$ RC	$0\cdot5/1\cdot0$	-	$12\cdot0/10\cdot0$	N/N	+/+	= = / N N / = =	N N / N N / N =	RLL. 10x10 LLL. 8x4 17x4	Ext. loc.
G.B.	F.7.	$0\cdot5/0\cdot5$	$4\cdot0/5\cdot0$	$11\cdot5$/NM	dil/N	+/+ RML	N N / = =	N N / = =	RLL 15x15	Gen.
H.B. a)	F.7.	$1\cdot0/2\cdot5$	$2\cdot5/6\cdot0$	$12\cdot5/9\cdot5$	N/N	nil	N N / N N / N N	N N / N N / N N	nil	Normal
b)	F.7.	$^{0}/2\cdot5$	$2\cdot5/6\cdot0$	$12\cdot0/9\cdot5$	N/N	nil	N N / N N / N N	N N / N N / N N	nil	Normal

Radiological Observations and Measurements in Patients in Group I.

Patient	DIAPHRAGM Sh/Ll	Move L/R	RsS. Dp/D.E.	T.C/T.H. diameter	PA/HA	Comp. fiss/V.Cr	Mid lung Vessels	Vessel loss	Dem. Bullae	Rad. Diagnosis
J.E. a)	C.7.	-	$\frac{4\cdot0}{12\cdot0}$	$\frac{9\cdot0}{9\cdot5}$	dil/N	nil	N N N N	N N N N	nil	Loc.
b)	F.6½	$\frac{3\cdot0}{2\cdot0}$	$\frac{4\cdot0}{12\cdot0}$	$\frac{9\cdot0}{9\cdot5}$	dil/N	nil	N N N N	N N N N	nil	Loc.
R.G.	LF 6½ RC	$\frac{2\cdot5}{1\cdot9}$	$\frac{4\cdot0}{6\cdot0}$	$\frac{11\cdot5}{11\cdot0}$	dil/N	nil	- - N - + -	- - N - N -	L.L.L. 4 x 12	Ext.Loc.
S.G.	LF 7½ RC	$\frac{3\cdot5}{2\cdot5}$	$\frac{5\cdot5}{1\cdot5}$	$\frac{11\cdot5}{10\cdot0}$	N/N	nil	N - N - N -	- - N - N -	L.U.L. 13 x 6 L.L.L.4x4	Ext. Loc.
R.H. a)	F.7.	-	$\frac{6\cdot0}{2\cdot0}$	$\frac{13\cdot5}{11\cdot0}$	N/dil	+/+ RML	+ N + - - -	N N N N - -	nil	Gen. Kyphosis
b)	F6½	$\frac{2\cdot5}{1\cdot5}$	$\frac{6\cdot0}{2\cdot0}$	$\frac{14\cdot0}{11\cdot0}$	N/dil	+/+ LLing	+ + ± -	N N N N	nil	Gen. Kyphosis
T.J.	F.6.	$\frac{0}{0\cdot5}$	$\frac{5\cdot5}{4\cdot0}$	$\frac{11\cdot5}{}$	N/dil	+/+ RUL	- N - N	N N - N	RLL 10x10 RUL 10x10	Gen.
T.F.	F 6½	-	-	$\frac{15\cdot5}{13\cdot5}$	dil/dil	nil	+ + N N - N	N N N N - N	RLL 11x12	Loc. Pulm.Hyper.*
J.McM.	F 6½	$\frac{0}{0}$	$\frac{6\cdot3}{3\cdot0}$	$\frac{10\cdot5}{}$	N/N	+/+ Ling	N N N N -	N N N N N -	LLL 26x6 RUL 7x7	Gen. Old T.B.
W.McD.	C 7½	$\frac{1\cdot0}{1\cdot0}$	$\frac{2\cdot5}{5\cdot0}$	$\frac{14\cdot0}{13\cdot0}$	dil/dil	+/+ RUL	- - - - N N	- - - - N N	nil	Loc. Pulm.Hyper.

* Pulm. Hyper. - Pulmonary Hypertension.

Radiological Observations and Measurements in Patients in Group I.

Patient	DIAPHRAGM Sh/Ll	Move L/R	RsS. Dp/D.E.	T.C./T.H. diameter	PA/HA	Comp. fiss/V.Cr.	Mid Lung Vessels	Vessel loss	Dem. Bullae	Rad. Diagnosis
C.M.	F.7.	0·5/0·5	5·0/2·0	11·5/11·0	dil/dil	nil	– – – – N –	– – N N N –	nil	Gen.
T.P. a)	FL 6 RC	1·0/1·0	5·0/3·5	12·5/12·0	dil/dil	nil	N N N N N –	– – N – N –	LLL 15x15	Ext. Loc.
b)	C 6½	1·5/3·0	5·0/4·0	13·0/12·5	dil/dil	nil	N N N N N N	– – N N N N	LLL 4x4 4x4	Pulm. hypert.
L.Car.	C.7.	2·0/1·5	4·5/5·0	11·0/12·0	N/N	+/+ RLL	– – – – N N	– – – – N N	nil	Ext. Loc.
A.S. a)	F.7½	0/0	3·0/6·0	9·0/11·0	N/dil	RML	N N N N – –	N N N N – –	RLL 10x10 20x20	Loc.
b)	F.7.	2·5/2·0	3·0/6·0	11·5/11·5	N/dil	nil	N N N N – –	N N N N – –	RLL 12x12	Loc.
G.P.	C.7½	1·5/1·5	4·0/4·0	10·5/10·5	N/N	nil	– – – N N N	– N – N N N	nil	Loc.
W.Sm.	F.7.	1·5/2·0	3·5/2·0	10·0/10·5	dil/dil	nil	– – – – – –	– – – – – –	nil	Gen.
J.K.	F.7.	0·5/0·5	4·5/4·0	14·5/13·5	N/dil	+/+ RLL	– – – – + +	– – N – N –	nil	Gen. Pulm. Hypert.
A.H.	C.6½	5·0/5·0	4·5/4·0	14·0/12·0	N/N	nil	N – N – N N	– – N – N N	LUL 12x12 RUL 4x4	Loc.

Radiological Observations and Measurements in Patients in Group I.

Patient	DIAPHRAGM Sh/LL.	DIAPHRAGM Move L/R	RsS. Dp/D.E.	T.C/T.H. diameter	PA/HA	Comp. fiss/V.Cr	Mid Lung Vessels	Vessel loss	Dem. Bullae	Rad. Diagnosis
J.H.	F.6½	2·5/1·5	6·5/0	12·5/12·0	dil/dil	nil	+ + – N – –	N N – N – –	RLL 5 x 5	Gen.
N.S.	F.6½	2·0/1·0	5·5/0	9·5/–	N/N	nil	– N N – N –	– N N – N –	LLL 7·5 x 7·5	Ext. Loc. Old T.B.
A.V.	F.7	–	4·0/0	11·0/9·0	N/dil	nil	– – – – + +	– – – – N N	nil	Gen.
G.T.	F.8	1·0/1·0	6·0/0	10·5/12·0	dil/dil	nil	– – N – – –	– – N – – –	LLL 15 x 15	Gen.
S.B.			Radiographs not available.							
C.B.	F.6½	2·0/1·5	2·0/5·0	9·5/9·5	dil/N	nil	N N – – – –	N N – – – –	nil	Gen.
T.C.	F.7.	–	6·0/1·0	12·5/14·0	dil/dil	nil	– – – – – –	– – – – – –	nil	Gen.
R.F.	F.6½	3·5/3·0	5·5/1·0	13·5/11·5	N/N	nil	N N N N N N	N N N N – –	nil	Loc.
J. Hud.	C.6.	1·5/2·5	1·5/7·0	14·0/9·5	N/N	nil	N N – –	N N N N N N	RLL 4·5 x 5·0	Loc.
L. Cun.	F.7.	0·5/0·5	4·0/1·0	9·0/10·5	N/dil	nil	– – N –	– – N N	nil	Gen.

Radiological Observations and Measurements in Patients in Group I.

Patient	DIAPHRAGM Sh/Ll.	Move L/R	RsS Dp/D.E.	T.C/T.H. Diameter	PA/HA	Comp. fiss/V.Cr.	Mid Lung Vessels	Vessel loss	Dem. Bullae	Rad. Diagnosis
D.C.	LF RC $7\frac{1}{2}$	$0{\cdot}5/3{\cdot}0$	$3{\cdot}0/8{\cdot}0$	$10{\cdot}0/9{\cdot}0$	N/N	nil	$\frac{-}{N}$ $\frac{-}{-}$ $\frac{N}{N}$ $\frac{-}{-}$	$\frac{N}{N}$ $\frac{-}{-}$ $\frac{N}{N}$ $\frac{-}{-}$	LUL 13x13	Ext. Loc.
A.M.	C.7.	$3{\cdot}0/3{\cdot}0$	$2{\cdot}5/-$	$13{\cdot}0/11{\cdot}0$	N/N	nil	$\frac{N}{N}$ $\frac{N}{N}$ $\frac{N}{N}$ $\frac{N}{N}$	$\frac{N}{N}$ $\frac{N}{N}$ $\frac{N}{N}$ $\frac{N}{-}$	LLL 10x10	Loc.
J.C.	$C.6\frac{1}{2}$	$4{\cdot}5/4{\cdot}5$	$4{\cdot}5/6{\cdot}0$	$14{\cdot}5/11{\cdot}5$	dil/dil	+/+	$\frac{-}{N}$ $\frac{-}{N}$	$\frac{-}{N}$ $\frac{-}{N}$	nil	Ext. Loc.
G.F.	$F.6\frac{1}{2}$	$4{\cdot}0/4{\cdot}5$	$2{\cdot}5/3{\cdot}5$	$15{\cdot}5/12{\cdot}0$	N/N	+/+ RML	$\frac{-}{N}$ $\frac{N}{N}$	$\frac{N}{N}$ $\frac{N}{N}$	RUL 10x10	Loc.
Gl.H a)	F.7.	$0{\cdot}5/0{\cdot}5$	$2{\cdot}5/5{\cdot}0$	$11{\cdot}5/8{\cdot}5$	dil/N	nil	$\frac{-}{N}$ $\frac{-}{N}$	$\frac{-}{N}$ $\frac{-}{-}$	nil	Gen.
b)	F.7.	$1{\cdot}0/1{\cdot}0$	$3{\cdot}0/4{\cdot}5$	$10{\cdot}5/9{\cdot}5$	dil/N	nil	$\frac{-}{N}$ $\frac{N}{N}$	$\frac{-}{N}$ $\frac{N}{-}$	nil	Gen.
c)	F.7.	$1{\cdot}0/0{\cdot}5$	$3{\cdot}0/4{\cdot}5$	$11{\cdot}0/11{\cdot}0$	dil/N	nil	$\frac{N}{N}$ $\frac{N}{N}$	$\frac{-}{N}$ $\frac{N}{-}$	RLL 6x6	Gen.
A.V.M. a)	$C.6\frac{1}{2}$	$1{\cdot}0/3{\cdot}0$	-	$13{\cdot}5/10{\cdot}5$	N/N	nil	$\frac{N}{N}$ $\frac{N}{N}$	$\frac{N}{N}$ $\frac{N}{-}$	RLL 9x9	Loc.
b)	$C.6\frac{1}{2}$	$4{\cdot}0/3{\cdot}0$	-	$13{\cdot}5/10{\cdot}5$	N/N	nil	$\frac{N}{N}$ $\frac{N}{N}$	$\frac{N}{N}$ $\frac{N}{N}$	RLL 9x9	Loc.

Radiological Observations and Measurements in Patients in Group I.

Patient	DIAPHRAGM Sh/Ll	Move L/R	RsS. Dp/D.E.	T.C/T.H. diameter	PA/HA	Comp. fiss/V.Cr	Mid Lung Vessels	Vessel loss	Dem. Bullae	Rad. Diagnosis
Geo.H a)	LF $6\frac{1}{2}$ RC	3·5/2·0	4·5/5·5	13·0/	N/N	nil/+ LLL	— N N	— N N	LLL 18x18	Loc.
b)	LF $6\frac{1}{2}$ RC	0·5/1·5	4·5/5·0	11·5/	dil/dil	+/+ LLL	— N N	N N N	nil	Gen.
E.P. a)	F.7.	0·5/0·5	3·5/5·0	9·0/10·0	dil/dil	nil	— — +	— — N	nil	Gen.
b)	F.$6\frac{1}{2}$	2·0/1·4	3·5/5·0	8·5/10·5	dil/dil	nil	— — N	— — N	RUL 5x5	Gen.
A.R.	C.7.	0·5/0·5	7·0/7·0	14·0/11·0	dil/N	nil	— — N	N N N	nil	Ext. Loc.
W.Sh a)	F.$6\frac{1}{2}$	1·0/0·5	5·0/0	11·0/9·5	dil/N	nil	N — —	N — —	nil	Gen.
b)	F.$6\frac{1}{2}$	0·5/0·5	5·0/1·0	13·0/9·5	dil/N	nil	N — —	N — —	RLL 3x3	Gen.
J.W. a)	F.$6\frac{1}{2}$	1·0/1·0	5·0/5·0	10·0/11·5	N/N	nil	— + —	— N —	nil	Gen.
b)	F.7.	3·0/2·0	5·0/5·0	9·5/	N/N	nil	— + —	— N —	RLL 7x7,7x7	Gen.

Radiological Observations and Measurements in Patients in Group I.

Patient	DIAPHRAGM Sh/Ll	Move L/R	RsS Dp/D.E.	T.C/T.H. diameter	PA/HA	Comp. fiss/V.Cr	Mid Lung Vessels		Vessel loss		Dem. Bullae	Rad. Diagnosis
W.P. a)	C.6½	4·0/4·0	2·0/4·5	12·5/10·0	N/N	nil	N = =	N N =	N = =	N N =	RLL 8 x 8	Ext. Loc.
b)	C.6½	4·0/3·5	3·0/	12·5/10·0	N/N	nil	N = =	N N =	N = =	N N =	nil	Ext. Loc.
R.P.	C.7.	3·5/3·5	4·5/1·0	11·5/11·5	N/dil	nil	= = N	= = N	= = N	= = N	nil	Loc.
P.J.	F.7.	0·5/2·0	5·0/1·0	11·0/10·5	dil/dil	nil	= = =	= = =	= = =	= = =	nil	Gen. Kyphosis
H.K.	C.6.	3·0/2·0	4·5/0	12·0/10·5	N/N	+/+LLL	N N N	N N N	= = =	= = N	Multiple both lungs	Ext. Loc.
E.Sh a)	F.6½	2·0/0·5	2·5/1·0	12·0/	N/N	nil	= = =	= N =	= = =	= N =	RUL 5x5 RLL 15x12 LLL 8x8	Gen.
b)	C.6	3·5/7·0	2·5/1·5	13·0/10·5	N/N	nil	= = =	= N =	N N =	= N =	RML 7x7 RLL 6x6 LLL 8x8	Gen.
J.S.	C.6½	3·0/3·5	2·5/5·0	9·5/10·0	N/dil	nil	= = N	= = N	= = N	= = N	nil	Ext. Loc.
C.Mah	F.6½	1·5/2·0	2·0/3·0	9·5/11·0	N/dil	nil/+RLL	= = =	= = =	N = =	= = =	RLL 12x12 LLing 3x3	Gen.
N.H.	F.7.	0/3·5	3·0/0	9·0/9·5	dil/dil	+/+ RUL	= = =	N N =	= = =	N N =	RLL 20x20 LLL 23x15	Gen.

Radiological Observations and Measurements in Patients in Group II.

Patient	DIAPHRAGM Sh/Ll	DIAPHRAGM Move L/R	RsS. Dp/D.E.	Diameter T.C/T.H.	PA/HA	Comp. fiss/V.Cr	Mid lung Vessels	Vessel Loss	Dem. Bullae	Rad. Diagnosis
E.N.	C/6½	½/0	2½/6	12·5/10·5	N/N	nil	N N N N N N	N N N N N N	nil	Normal
L.M.	C/6½	4/4	4/7	13·0/9·5	N/N	nil	N N N N N N	N N N N N N	nil	Normal Kyphosis
E.G.	C/7	½/½	3/7	16·0/14·0	N/dil	nil	+ + N N N N	N N N N N N	nil	Normal
F.K.	F/7½	2/3	2½/5	15·5/12·0	N/dil	nil	N N N N N N	N N N N N N	nil	Normal
R.T.	C/6½	½/½	3/10	12·5/0·5	dil/N	nil	+ + N N N N	N N N N N N	nil	Normal
E.S.	C/6	2/2	5/5	12·5/11·0	dil/dil	nil	N N N N N N	N N N N N N	nil	Normal Pulmonary Hypert.
E.pat.	C/6½	¾/1	2½/10	14·0/-	dil/dil	nil	N N N N N N	N N N N N N	nil	Normal Pulmonary Hypert.
F.R.	C/6	3/3	2/8	12·5/11·5	dil/N	nil	N N N N N N	N N N N N N	nil	Normal

$F.E.V._1$ Static Lung Volumes, Airways Resistance and Diffusing Capacity in Patients in Group I.

Patient	FEV_1	$\frac{FEV_1}{FVC}$ %	V.C.	FRC	RV	RV/TLC%	A.R.	REST $D_{L_{CO}}$	REST M.V.	REST %Extr.	EXERCISE $D_{L_{CO}}$	EXERCISE M.V.
F.B.	2000	46	4·50	7·55	5·65	56	-	5·7	11·1	23	8·4	21·8
R.K. a)	600	25	3·60	6·03	4·42	55	4·85	7·8	10·0	30	11·3	18·0
b)	600	23	3·90	5·23	3·53	48	5·37	6·8	7·2	35	13·2	27·6
E.St.	600	25	2·65	5·00	4·15	61	5·05	6·9	10·5	26	8·7	19·8
G.B.	550	34	2·00	4·70	4·10	67	-	6·8	12·2	25	-	-
H.B. a)	600	25	2·90	3·66	2·36	45	-	7·4	8·9	34	11·7	20·8
b)	800	26	3·00	4·45	3·45	53	6·15	6·03	8·25	30	9·96	16·1

FEV_1 Forced Expired Vol. in 1 sec. (ml.)
FVC Forced Vital Capacity (ml.)
VC Vital Capacity
FRC Functional Residual Capacity (litres)
RV Residual Volume

A.R. Airways Resistance ($cmsH_2O$/litre)
$D_{L_{CO}}$ Diffusing Capacity for Carbon Monoxide (ml.CO/mm.Hg/min.)
M.V. Minute Ventilation (litres)
% Extr. Percentage Extraction of Carbon Monoxide

$F.E.V._1$ Static Lung Volume, Airways Resistance and Diffusing Capacity in Patients in Group I.

Patient	FEV_1 ml.	$\frac{FEV_1}{FVC}$%	V.C.	FRC	RV	RV/TLC%	A.R.	REST D_{LCO}	REST M.V.	REST %Extr.	EXERCISE D_{LCO}	EXERCISE M.V.
J.E. a)	1050	29	3·80	5·31	3·81	50	3·24	7·1	7·8	37	15·3	32·2
b)	1200	35	3·75	4·92	3·72	50	2·94	4·9	6·6	30	11·0	24·0
R.G.	2000	59	3·80	4.05	2·65	41	2·15	12.0	13·3	26	12·0	25·0
S.G.	350	27	1.80	5·61	4·71	72	8·06	6·6	7·6	32	9·6	12·6
R.H. a)	1050	42	2·15	5·48	4·98	70	-	6.0	11·0	25	7·1	16·8
b)	400	29	2·30	6.15	5·30	70	-	5.8	8.1	29	8·6	15·3
T.J.	500	29	2·85	5·91	4·26	60	-	5·9	9·2	28	-	-
T.F.	700	41	2·00	3·32	2·19	52	7·80	5·5	10.9	23	8.1	15.3
J.McM.	350	37	1·60	7·40	7·10	82	-	7·7	7·1	40	9.3	9.0
W.McD.	600	25	2·50	7·66	6·56	73	-	8.2	12.0	38	-	-

$F.E.V._1$ Static Lung Volumes, Airways Resistance and Diffusing Capacity in Patients in Group I.

Patient	$F.E.V._1$ ml.	$\frac{FEV_1}{FVC}$ %	V.C.	FRC	RV	RV/TLC%	A.R.	REST D_{LCO}	REST M.V.	REST %Extr.	EXERCISE D_{LCO}	EXERCISE M.V.
C.M.	400	22	2·00	8·40	7·70	80	-	9·0	8·6	29	18.2	12·6
T.P. a)	900	33	3·20	5·12	4·50	59	4·08	9·1	11·6	30	16·4	18.4
b)	750	26	3·30	4·65	4·15	58	5·28	7·0	7·5	39	13·4	15·0
L.Car	700	28	2·60	6·87	5·93	70	10·95	5·7	8.0	26	12·1	16·8
A.S. a)	500	30	2·20	6·44	5·84	73	7·38	7·2	8·6	33	-	-
b)	600	33	2·50	6·25	5·05	65	4·83	8·4	9·7	33	10·4	16·8
G.P.	550	28	3·20	7·10	5·90	65	3·64	8·6	8·7	33	15°2	16·8
W.Sm	500	42	1·65	7·65	7·10	81	-	6·1	8·6	27	7·1	11·4
J.K.	800	37	2·20	5·78	4·85	69	-	6·1	11·3	26	7·6	17.1
A.H.	2300	58	4·30	4·68	3·25	43	4.6	8·5	12.6	26	19·9	22·5

F.E.V.$_1$ Static Lung Volumes, Airways Resistance and Diffusing Capacity in Patients in Group I.

Patient	F.E.V.$_1$ ml.	$\frac{FEV_1}{FVC}$ %	V.C.	FRC	RV	RV/TLC %	A.R.	REST D_{LCO}	REST M.V.	REST % Extr.	EXERCISE D_{LCO}	EXERCISE M.V.
J.Her	600	27	2·10	4·60	3·90	65	6.45	7·1	10·2	28	11.4	21·6
N.S.	900	36	2·45	4·94	4.04	62	4·60	6·6	7·5	33	9·7	15.4
G.T.	300	25	1·60	6·53	5·93	79	5.60	4·1	5·8	32	-	-
A.V.	550	24	2.80	7·80	6·85	71	4·53	5·7	7·5	32	5·8	10·5
S.B.	1600	64	2·50	3·72	2.82	53	4·68	11·4	12·3	32	19.2	20·0
C.B.	600	27	2·20	4·58	3·58	62	7·20	6·0	8·5	29	11·6	18·4
T.C.	1000	39	3·05	9·80	8·75	74	-	12·6	16·8	28	-	-
R.F.	1000	23	3·70	5·41	3·71	50	3·00	11.2	13·4	32	14·0	23·0
J.Hud	800	37	2·50	3·72	2·62	51	6·00	8·1	13·4	25	11·4	22·4
L.Cun	500	46	1·40	5.65	5·27	79	-	4.6	7·5	30	-	-

$F.E.V._1$ Static Lung Volumes, Airways Resistance and Diffusing Capacity in Patients in Group I.

Patient	$F.E.V._1$ ml.	$\frac{FEV_1}{FVC}$ %	V.C.	FRC	R V	RV/TLC %	A.R.	REST D_{LCO}	REST M.V.	REST %Extr.	EXERCISE D_{LCO}	EXERCISE M.V.
D.C.	350	19	1·80	5·22	4·42	71	10·40	10·4	8·8	33	11·0	14·4
A.M.	1100	48	3·15	4·50	3·50	53	3·05	13·5	14·4	36	17·7	25·6
J.C.	800	34	2·95	5·87	4·97	63	4.45	4·9	8·7	24	8·1	17·1
G.F.	1900	45	4·70	5.45	4·35	48	2·15	11·3	10·3	36	24·2	32·0
Gl.H. a)	300	30	1·40	4·85	4·60	77	-	5·7	5·2	40	-	-
b)	400	22	2·10	4·39	3·49	63	11·80	5·3	7·1	31	-	-
c)	500	23	2·20	3·75	2·86	56	4·90	4·8	8·6	26	6·0	13·8
A.V.M. a)	900	38	4·40	4·30	2·70	38	3·80	7·4	12·1	26	11·0	22·0
b)	1200	38	3·60	4·05	2·95	45	3·70	8·5	12·0	29	12·9	26·4

$F.E.V._{.1}$, Static Lung Volumes, Airways Resistance and Diffusing Capacity in Patients in Group I.

Patient	$F.E.V._{.1}$ ml.	$\frac{FEV_1}{FVC}$ %	V.C.	FRC	R.V.	RV/TLC %	A.R.	REST D_{LCO}	REST M.V.	REST %Extr.	EXERCISE D_{LCO}	EXERCISE M.V.
Geo.H. a)	800	24	3·40	4·50	3·70	52	-	10·9	8·4	38	19·8	22.2
b)	600	24	3·10	5·97	4·87	61	-	10·5	10·6	34	10·8	12·8
E.P. a)	250	23	1·20	4·45	3·98	78	-	3·0	6·8	22	-	-
b)	300	23	1·15	4·00	3·60	78	-	4·9	6·2	29	-	-
A.P.	600	21	2·90	6·54	5·24	64	-	12·6	7·8	48	19·8	18.8
W.Sh a)	1000	33	3·25	4·59	3·54	52	-	6·0	11·0	25	8·3	20.0
b)	1100	28	4·45	4.85	2·85	42	3.17	5·2	10.6	23	9·2	22.4
J.W. a)	500	28	1·80	7·26	6·46	78	4·26	6.6	12.6	23	-	-
b)	500	30	2·20	8·80	8·00	78	-	4·0	7·9	24	5·7	12·0

$F.E.V._1$, Static Lung Volumes, Airways Resistance and Diffusing Capacity in Patients in Group I.

Patient	$F.E.V._1$ ml.	$\frac{FEV_1}{FVC}$ %	V.C.	FRC	R.V.	RV/TLC %	A.R.	REST $D_{L_{CO}}$	REST M.V.	REST %Extr.	EXERCISE $D_{L_{CO}}$	EXERCISE M.V.
W.P. a)	600	40	2·40	4·41	4·21	64	-	11·8	14·5	33	15·7	19·8
b)	600	33	2·60	4·23	3·53	58	-	10·2	9·1	39	12·9	24·3
R.P.	2300	56	3·85	5.46	3·91	50	1·50	8·5	9·5	30	13·3	15·6
P.J.	900	32	2·60	9·00	7·85	75	-	4·7	7·9	25	5·9	13·6
H.K.	800	25	4·20	4·39	2·59	38	-	11·4	14·2	33	14·4	20.8
E.Sh. a)	900	43	2·40	3·08	2·32	48	4·05	7·7	11·6	28	9·9	21·0
b)	1300	33	3·70	4·38	3·20	47	4·52	6·7	9·5	29	12.0	19·0
J.S.	900	26	4·30	5·02	3·90	48	5·20	8·6	6·4	38	12·9	18·0
C.Mah	800	25	3·20	7·75	6·05	62	-	5·0	15·5	17	4·5	19.2
N.H.	500	46	1·25	3·11	2·98	70	-	8.1	9·0	34	9·4	12·5

$F.E.V._1$ Static Lung Volumes, Airways Resistance and Diffusing Capacity in Patients from Group II

Patient	$F.E.V._1$ (ml)	$\frac{F.E.V.1}{F.V.C.}$ %	V.C.+	F.R.C.+	R.V.+	RV/TLC%	A.R.+	REST D_{LCO}+	REST M.V.+	REST %Extr.+	EXERCISE D_{LCO}+	EXERCISE M.V.+
E.N.	600	40	2·00	5·45	4·95	71	-	7·9	8·0	35	8·6	13·7
L.M.	800	36	2·50	4·61	3·91	61	3·77	11·4	14·7	30	16·7	28·9
E.G.	1500	52	2·90	5·00	4·38	65	3·12	17·1	18·0	32	32·0	32·2
F.K.	600	32	2·45	5·08	4·18	63	5·10	4·8	5·6	29	6·6	9·4
R.T.	450	32	2·35	4·46	4·04	63	-	5·9	9·4	27	6·1	12·5
E.Sc.	500	33	1·60	3·90	3·30	67	-	7·3	8·4	31	-	-
E. Pat.	500	29	1·80	5·15	4·65	72	7·10	6·9	6·6	39	7·3	9·2
F.R.	1000	48	2·85	4·70	4·10	59	3·82	8·7	7·8	33	18·8	17·6

$F.E.V._1$ Forced Expired Vol. in 1 sec. (ml.)
F.V.C. Forced Vital Capacity (ml.)
V.C. Vital Capacity
F.R.C. Functional Residual Capacity litres.
R.V. Residual Volume.
A.R. Airways Resistance ($cmsH_2O$/litre)
D_{LCO} Diffusing Capacity for Carbon Monoxide (ml.CO/mm.Hg/min)
M.V. Minute Ventilation (litres)
% Extr. Percentage Extraction of Carbon Monoxide.

$F.E.V._{.1}$, Static Lung Volumes, Airways Resistance and Diffusing Capacity in Patients in Group III.

Patient	$F.E.V._{.1}$ ml.	$\frac{FEV_1}{FVC}$%	V.C.	FRC	R.V.	RV/TLC%	A.R.	L.V.*	REST			EXERCISE	
									$D_{L_{CO}}$	M.V.	% Extr.	$D_{L_{CO}}$	M.V.
M.E.	1800	69	2·60	2·18	1·78	41	3·85	2·01	17·7	11·0	49	17·9	15·0
A.K.	1000	38	3·10	4·03	3·78	55	8·30	7·65	9·4	13·0	30	15·2	21·6
A.S.	900	31	3·50	4·90	3·20	48	3·70	5·92	8·9	8·7	37	12·0	19·0
E.L.	650	32	2·40	4·28	3·58	60	4·25	6·32	10·4	7·0	44	13·2	15·4
D.C.	1000	40	3·50	4·81	4·06	54	5·20	8·10	9·1	10·1	39	27·8	27·6
M.D.	900	37	2·80	4·32	3·32	54	9·54	5·30	20·9	10·4	48	22·4	20·9
H.S.	1200	67	2·05	2·12	1·72	44	4·04	2·42	9·8	11·3	33	13·4	23·8

* Denotes Lung Volume while panting in body plethysmograph (litres).

Arterial Blood Gases, pH at rest and after exercise and Derived Values in Patients, in Group I*.

Patient	Pa_{O_2} rest mm. Hg.	Pa_{O_2} Ex. mm.Hg.	Pa_{CO_2} rest mm. Hg.	Pa_{CO_2} Ex. mm. Hg.	pH	% Satn. Hb	RESTING VALUES V_D/V_T	V_A l/min.	$P_A-a_{O_2}$ mm.Hg.	Work Kgm/mins.
F.B.	96·5	81·0	35	33	7·41	97·0	0·58	3·5	7·4	458 (3)
E.St.	82·5	73·8	40	49	7·36	94·7	0·62	4·6	24·9	244 (2)
G.B.	65·0	-	33	-	7·40	91·5	-	-	-	-
H.B. b)	90·5	84·0	37	32	7·40	96·5	0·47	5·2	12·3	180 (5)
J.E. a)	74·0	-	33	-	7·38	93·5	-	-	-	-
J.E. b)	88·0	85·0	35	37	7·37	96·0	0·46	6·8	16·3	266 (3)
R.G.	85·0	91·0	36	40	7·41	96·0	0·62	3·7	16·8	328 (5)
S.G.	88·0	-	46	-	7·38	96·0	-	-	-	-
R.H. a)	61·5	-	41	-	7·39	89·5	-	-	-	-
R.H. b)	89·6	64·0	40	47	7·36	96·0	0·47	5·1	16·8	245 (2)
T.J.	48·0	-	64	-	7·33	81·0	-	-	-	-
T.F.	75·5	71·0	62	65	7·37	93·7	0·67	2·8	5·5	171 (3)

* Pa_{O_2}-arterial oxygen tension,
Pa_{CO_2}-arterial carbon dioxide tension,
% Satn. Hb -Percentage saturation of oxyhaemoglobin.

V_D/V_T - ratio of dead space volume to tidal volume,
$P_A-a_{O_2}$ - alveolar arterial oxygen tension difference,
V_A - alveolar ventilation.

Arterial blood gases, pH at rest and after exercise and Derived Values in Patients in Group 1.

Patient	Pa_{O_2} rest mm. Hg.	Pa_{O_2} Ex. mm.Hg.	Pa_{CO_2} rest mm.Hg.	Pa_{CO_2} Ex. mm. Hg.	pH	% Satn. Hb	RESTING VALUES V_D/V_T	VA l/min.	$P_A-a_{O_2}$ mm.Hg.	Work Kgm/mins
A.H.	98·5	104	41·5	41·5	7·37	97	0·48	7·8	3·0	350 (4)
J.Her	72.5	57·5	55	62	7·34	92	0·62	3·4	24	213 (3)
N.S.	94·5	95·5	45	45	7·37	96·5	-	-	-	155 ($1\frac{1}{2}$)
G.T.	63	-	62	-	7·38	90·0	-	-	-	-
A.V.	98·5	-	40	-	7·43	97·5	-	-	-	-
S.B.	79·5	76·5	43	41	7·44	91·5	0·57	4·5	17·1	232 (3)
C.B.	99·5	100	44·0	45·0	7·36	-	-	-	-	145 (3)
T.C.	64·0	73·0	40·0	45·0	7·41	91·5	-	-	-	152 (2)
R.F.	87·0	77·5	37	36·5	7·39	96	0·59	5·7	25·4	327 (5)
J.Hud.	89.5	81·0	48·0	53·0	7·38	96	0·68	3·3	2·5	205 (2)

Arterial blood gases, pH at rest and after exercise, and derived values in Patients in Group I.

Patient	PaO_2 rest mm.Hg.	PaO_2 Ex. mm.Hg.	$PaCO_2$ rest mm. Hg.	$PaCO_2$ Ex. mm. Hg.	pH	% Satn. Hb	RESTING VALUES V_D/V_T	V_A l/min	$P_{A-a}O_2$ mm.Hg.	Work Kgm/mins.
J.McM.	72·0	56·0	56	52	7·34	92	-	-	-	184 (1½)
W.McD.	86·0	-	41	-	7·42	96	-	-	-	-
C.M.	80·5	73·5	54	57	7·35	94·5	0·41	4·7	8·5	166 (2)
T.P. a)	89·9	68·5	56	43	7·38	96·5	-	-	-	194 (3)
T.P. b)	83·7	80·5	47	54	7·34	94·5	0·56	4·9	6·8	250 (3)
L.Car	91·0	76·5	37·0	44·0	7·46	97.2	0·47	4·9	17·5	194 (2)
A.S. a)	82·5	77·0	45	-	7·39	95	-	-	11·0	190 (3)
A.S. b)	95·0	82·5	42·0	47·0	7·38	96·5	0·54	3·6	13·7	190 (3)
G.P.	94·5	83·5	42	42	7·41	95	0·61	3·35	16·2	204 (2)
W.Sm.	85·0	-	52	-	7·37	95·5	-	-	-	-
J.K.	70·0	58·5	50	52·5	7·33	91·3	0·57	6.1	26.0	136 (1)

Arterial blood gases, pH at rest and after exercise, and derived values in patients in Group I.

Patient	PaO_2 rest mm. Hg.	PaO_2 Ex. mm.Hg.	$PaCO_2$ rest mm. Hg.	Pa_{CO_2} Ex. mm. Hg.	pH	% Satn. Hb.	RESTING VALUES V_D/V_T	V_A l/min.	P_A-aO_2 mm.Hg.	Work Kgm./Mins
L.Cun.	77·7	75·0	50	43	7·39	94·2	0·70	2·4	48·7	222 (2)
D.C.	99	104	35	39	7·37	97	0·57	4.6	10	191 (3)
A.M.	81	101	35	-	7·42	95	0·58	6.2	27·8	310 (3)
J.C.	83·0	61·0	42·5	43	7·38	95·5	0.50	6·9	22·3	360 (2)
G.F.	91	98	37·5	34·5	7·42	97	0·50	5·8	11·7	450 (3)
Gl.H c)	94	-	34	-	7·40	97	0·57	2·7	18	-
A.V.M. a)	79	-	39	-	7·48	96	-	-	-	-
b)	94·5	91·0	33·5	33·5	7·41	97	0·43	7·3	14·0	240 (3)
Geo.H. b)	91·5	90·0	47	49	7·38	96·3	0·58	3·4	5·2	407 (2)

Arterial Blood Gases and pH At Rest and After Exercise and Derived Values In Patients in Group I.

Patient	Pa_{O_2} rest mm.Hg.	Pa_{O_2} Ex. mm.Hg.	Pa_{CO_2} rest mm.Hg.	Pa_{CO_2} Ex mm.Hg.	pH	% Satn. Hb	RESTING VALUES V_D/V_T	VA l/min.	A-aP_{O_2} grad.mm.	Work Done Kg.mm.
E.P. a)	60	-	45	-	7·42	90	-	-	-	-
b)	68	50	45	46	7·39	92	-	-	-	-
A.P.	93	97·5	45	43	7·35	96	0·49	4·2	11·2	240 (3)
W.Sh.b)	92·8	72·5	33·5	29·5	7·39	96·5	-	-	-	308 (2)
J.W. a)	53	58	47	57	7·35	83	-	-	-	260 (1)
b)	73·5	61·5	45	43	7·39	93·5	0·63	3·1	21.8	248 (1½)
W.P. a)	78·5	-	37	-	7·41	94·5	-	-	-	-
b)	75·0	88·0	31	37	7·42	94·5	0·50	6.0	17.4	270 (3)
R.P.	76	94·5	39	39	7·39	93·8	0·36	7·2	29·3	260 (3)
P.J.	80·3	68·0	44	48	7·37	94·5	0·64	4·2	16·1	177 (2)

Arterial Blood Gases and pH At Rest and After Exercise and Derived Values In Patients in Group I.

Patient	Pa_{O_2} rest mm.Hg.	Pa_{O_2} Ex. mm.Hg.	Pa_{CO_2} rest mm.Hg.	Pa_{CO_2} Ex mm. Hg.	RESTING VALUES pH	% Satn. Hb.	V_D/V_T	V_A l/min.	A-aP_{O_2} grad.mm.	Work Done Kg.mm.
H.K.	81·5	82·0	35·0	35·0	7·39	95	0·49	5·7	23·2	336 (3)
E.Sh. a)	78·0	85·5	38·5	38·0	7·38	94·5	-	-	-	285 (3)
b)	91·0	92·6	35	39	7·39	96·5	0·39	6·7	20	346 (3)
J.S.	95·5	100·5	42	40·5	7·35	96·5	0·46	3·1	7·3	290 (3)
C.Mah.	74·5	61·5	40	40	7·37	93	0·67	5·1	14·0	150 (1)
N.H.	88·5	85·0	32·5	33·0	7·37	95·7	0·37	7·0	17·4	165 (3)

Arterial Blood Gases At Rest and After Exercise, and Derived Values in Patients in Group II.

Patient	Pa_{O_2} rest mm.Hg.	Pa_{O_2} Ex. mm.Hg.	Pa_{CO_2} rest mm.Hg.	Pa_{CO_2} Ex mm.Hg.	RESTING VALUES pH	% Satn Hb.	V_D/V_T	V_A l/min.	A-aP_{O_2} grad.mm.	Work Done Kg. mm.	Minutes Work.
E.N.	52·3	58·5	52	52	7·39	85	0·50	4·4	16·5	285	3
L.M.	53·0	-	50	-	7·36	83	0·64	4·7	36·4	-	-
E.G.	73·5	80·5	47	52	7·40	93·5	0·72	2·8	13·0	315	3
F.K.	78·0	72·5	54	54·5	7·39	94·5	-	-	-	139	3
R.T.	62·0	51·0	59	73	7·32	87·5	0·71	4·0	4·0	143	1½
E.S.	75·0	53·0	50	55	7·38	93·5	0·67	3·0	8·2	126	4
E.Pat.	69·5	-	60	-	7·33	91·2	0·54	2·9	3·0	-	-
F.R.	76·0	70·8	47	55	7·37	93·5	0·66	3·6	14·5	334	3

Regional Ventilation and Perfusion in Patients in Group I.

Patient	Ventilation Index						Perfusion Index						Dynamic Distribution Index					
	R.U.	R.M.	R.L.	L.U.	L.M.	L.L.	R.U.	R.M.	R.L.	L.U.	L.M.	L.L.	R.U.	R.M.	R.L.	L.U.	L.M.	L.L.
F.B.	0·81	0·88	1·85	0·69	0·56	1·10	1·27	0·71	1·69	0·64	0·58	1·17	23·8	20·8	23·2	33·3	29·7	47.6
R.K. a)	1·65	0·90	0·76	1·82	0·88	0·68	1·66	1·60	1·26	1·15	0·55	0·58	66·7	41·2	28·1	48·5	43·6	23·9
b)	1·20	0·83	0·52	1·36	0·97	1·32	0·77	0·79	0·86	0·99	1·09	1·44	96·0	35·0	20·2	135	76·0	59·0
E.St.	1·05	1·41	0·65	1·35	0·87	0·53	0·98	2·13	0·82	0·71	0·88	0·53	61·0	50·8	26·8	33·0	34·8	20·8
G.B.	1·24	0·37	0·34	1·56	1·34	0·74	1·20	0·47	0·79	1·19	1·18	1·01	83·3	25·2	25·2	111·0	96·3	50·5
H.B. a)	0·81	1·20	0·82	1·32	1·02	0·51	1·08	1·65	0·89	0·63	0·71	0·89	65.0	57·7	27·0	80.0	29·4	23.9
b)	1·55	1.10	0·46	1·59	0·67	0·22	1·48	1·26	0·75	0·89	0·68	0·45	180	29·6	20·5	54·5	37·0	19.6
J.E. a)	1·48	0·93	0·31	1·43	1·03	0·25	1·44	1·05	0·32	1·44	0·87	0·33	70·0	34·9	13·4	44·9	25·4	14·9
b)	1·02	1·09	0·64	1·44	1·35	0·40	1·08	1·22	0·58	1·39	1·21	0·58	88·5	60·0	19·3	154·0	65·0	17·7
R.G.	0·63	1·06	1·28	0·71	0·89	1·42	0·34	0·84	2·68	0·31	0·53	1·21	26.8	49·6	55·5	39·4	63·3	111.0

R.U. - Right Upper Zone. L.U.- Left Upper Zone.
R.M. - Right Middle Zone. L.M.- Left Middle Zone.
R.L. - Right Lower Zone. L.L.- Left Lower Zone.

Regional Ventilation and Perfusion in Patients in Group I.

Patient	Ventilation Index						Perfusion Index						Dynamic Distribution Index					
	R.U.	R.M.	R.L.	L.U.	L.M.	L.L.	R.U.	R.M.	R.L.	L.U.	L.M.	L.L.	R.U.	R.M.	R.L.	L.U.	L.M.	L.L.
S.G.	0·66	1·00	1·54	0·87	0·98	0·62	1·00	0·92	1·26	0·64	1·05	1·04	49·0	44·0	29·4	52·0	72·5	35·0
R.H. a)	1·62	1·62	0·53	1·44	0·86	0·13	1·22	1·31	0·84	1·09	1·03	0·52	101	53·0	21·4	73·7	40·5	21·4
b)	2·06	1·30	0·37	1·39	0·86	0·43	1·43	1·25	0·59	1·42	1·00	0·47	122	40·0	21·1	65·5	45·1	24·3
T.J.	1·41	0·80	0·50	0·70	0·99	1·49	1·20	0·51	0·25	0·56	1·15	1·89	23·4	15·7	14·0	15·2	19·3	36·4
T.F.	1·42	0·86	0·45	0·91	1·42	0·54	1·47	1·23	0·53	0·81	1·02	0·63	80·0	23·2	18·1	48·6	41·3	39·6
J.McM.	0·50	0·98	1·52	0·62	1·15	1·03	0·52	1·31	2·09	6·22	0·56	0·48	43·4	61·3	112	43·5	43·7	38·0
W.McD.	0·69	0·63	1·36	0·43	0·68	1·63	0·57	0·47	1·44	0·30	0·48	1·96	30·0	27·5	57·0	32·5	49·5	156
C.M.	1·09	0·63	0·75	1·37	1·48	0·71	0·81	1·07	1·48	0·70	1·17	0·58	46·8	26·4	27·4	65·3	68·0	26·0
T.P. a)	0·94	1·25	1·07	1·14	0·71	0·76	0·66	1·43	1·78	0·37	0·56	1·00	74·5	83·5	74·5	74·5	27·5	33·3
b)	1·02	1·23	1·15	0·81	0·78	0·96	0·60	1·34	1·61	0·63	0·70	0·89	48·5	78·0	49·2	37·6	32·7	28·1

Regional Ventilation and Perfusion in Patients in Group I.

Patient	Ventilation Index						Perfusion Index						Dynamic Distribution Index					
	R.U.	R.M.	R.L.	L.U.	L.M.	L.L.	R.U.	R.M.	R.L.	L.U.	L.M.	L.L.	R.U.	R.M.	R.L.	L.U.	L.M.	L.L.
L.Car	0·38	0·92	1·19	0·36	1·61	1·22	0·35	0·77	1·54	0·42	1·28	1·36	27·6	32·8	49·0	24·2	39·6	50·0
A.S. a)	1·47	0·83	0·74	1·45	1.10	0·45	1·14	0·99	0·46	1·34	1·09	0·76	26·0	28·4	25·6	132·0	54·7	34·8
b)	1·46	1·11	0·54	1·34	1·05	0·63	1·04	1·01	0·89	1·01	1·12	0·86	73·0	62·0	21·0	85.0	36·0	22·0
G.P.	1·39	0·79	0·97	1·44	1·09	0·89	1·62	0·51	1·20	0·76	0·90	1·21	37·0	42·0	43·3	74·0	46·8	34·4
W.Sm.	0·55	0·94	1·56	1·03	0·72	1·23	0.67	0·94	1·75	0·71	0·97	0·94	37·0	38·2	97·0	56·2	28·4	46·2
J.K.	0·84	1·66	1·11	0·44	0·97	0·50	0·67	0·86	1.14	0·44	0·77	1·49	50·0	134	25·4	24·3	30·4	30·0
A.H.	0·84	1·12	0·93	0·66	1·14	1·21	0·49	0·92	1·42	0·71	0·76	1·66	26·0	52.3	89·0	27·4	44·5	61·7
J.Her.	1·42	0·97	0·69	1·60	0·75	0·44	1·45	1·15	1·01	1·05	0·73	0·64	46·8	26·0	21·4	119	25·6	20·9
N.S.	0·50	2·10	1·06	1·08	0.66	0·43	0·57	1.11	1·80	0·63	0·35	0·37	23·2	-	105	24·7	22·6	21·0
G.T.	2·78	0·90	1·40	0·62	0·50	0·79	2·76	1·23	1·44	0·56	0·32	0·53	52·3	41·4	59·5	32·2	35·6	32.2

Regional Ventilation and Perfusion in Patients in Group I.

Patient	Ventilation Index						Perfusion Index						Dynamic Distribution Index					
	R.U.	R.M.	R.L.	L.U.	L.M.	L.L.	R.U.	R.M.	R.L.	L.U.	L.M.	L.L.	R.U.	R.M.	R.L.	L.U.	L.M.	L.L.
A.V.	0·60	0·33	1·00	0·51	0·77	2·04	0·77	0·58	0·99	0·74	0·74	1·75	27·6	27·0	33·3	30·8	32·9	116·0
S.B.	1·08	1·04	0·71	1·23	1·24	0·78	1·01	1·08	0·94	0·72	1·10	1·08	116	42·7	36·4	79·3	121	46·3
C.B.	1·53	0·67	0·48	2·31	0·85	0·80	1·53	1·22	0·75	0·72	0·93	0·79	59·0	35·8	30·0	74·6	34·0	26·3
T.C.	0·77	1·40	1·03	0·88	1·18	0·46	0·47	1·22	1·26	0·60	1·39	0·84	28·4	104	25·2	39·1	71·5	21·0
R.F.	1·15	0·85	0·91	1·67	1·44	0·38	1·13	1·18	1·17	1·08	1·10	0·58	105	43·3	50·0	158	57·5	16·6
J.Hud.	1·30	1·02	0·59	1·23	1·14	0·75	1·22	1·19	0·45	1·30	1·17	0·64	64·2	66·0	36·5	44·0	44·0	35·5
L.Cun.	1·02	0·95	1·37	1·03	1·00	0·65	1·02	1·30	1·32	0·83	0·81	0·65	71·0	50·3	42·0	120	57·5	24·6
D.C.	1·40	1·09	1·04	1·18	0·76	0·37	1·00	1·19	1·41	0·74	0·67	0·35	90·5	73·5	49·1	40·0	30·8	30·3
A.M.	0·89	0·93	1·02	1·02	0·89	1·34	0·40	0·70	1·54	0·51	0·99	1·82	44·2	44·2	47·2	99·5	80·0	76·7
J.C.	1·34	1.40	1·12	0·48	0·85	1·25	0·51	1·10	1·42	0·63	0·69	1·28	25·4	14·1	50·5	16·7	16·5	29·5
G.F.	0·70	0·87	1·29	0·61	1·01	1·15	0·42	0·52	1·61	0·49	0·87	1·46	18·2	63·4	103	24·3	38·4	77·0

Regional Ventilation and Perfusion in Patients in Group I.

Patient	Ventilation Index						Perfusion Index						Dynamic Distribution Index					
	R.U.	R.M.	R.L.	L.U.	L.M.	L.L.	R.U.	R.M.	R.L.	L.U.	L.M.	L.L.	R.U.	R.M.	R.L.	L.U.	L.M.	L.L.
Gl.H. a)	0·27	0·36	1·33	0·29	0·48	1·31	0·67	0·52	1·49	0·44	0·63	2·06	20·2	27·4	72·0	19·9	20·4	41·7
b)	0·95	0·63	1·08	0·90	1·08	1·17	0·64	0·70	1·22	0·85	1·03	1·20	38·5	41·0	51·3	49·3	77·0	92·0
c)	0·91	0·87	0·97	0·71	0·07	1·32	0·58	0·71	1·03	0·89	1·17	1·32	43·7	43·5	69·0	60·5	60·0	65·3
A.V.M.a)	0·80	1·15	0·86	1·18	1·15	0·79	0·72	1·15	1·07	1·02	1·16	0·76	32·7	75·3	22·6	56·5	158	21·0
b)	1·18	1·36	0·61	0·93	1·11	0·48	0·51	0·69	0·54	1·56	1·73	0·93	35·0	32·7	19·8	40·3	123·0	24·9
Geo. H. a)	0·82	1·19	1·19	0·98	0·98	0·51	0·71	1·49	1·49	0·60	0·70	0·51	100	112	53·2	41·7	125	38·4
b)	0·80	1·06	0·71	1·66	0·89	1·08	0·60	1·11	1·34	0·89	0·89	1·01	53·2	42·5	26·1	54·6	53·2	24·7
E.P. a)	0·51	0·40	1·76	0·67	0·48	2·46	0·60	0·50	1·81	0·32	0·54	2·02	26·8	31·1	28·6	31·0	38·2	52·2
b)	0·80	1·05	1·33	0·59	0·45	1·65	0·90	0·82	1·48	0·40	0·46	1·80	24·6	46·4	50·8	23·3	25·0	42·3
A.P.	0·57	0·38	1·75	0·80	0·76	1·44	0·36	0·41	1·70	0·54	0·60	1·90	26·6	30·7	85·0	23·0	37·8	146.0
W.Sh a)	1·33	1.08	0·49	1·15	1·25	0·70	1·47	1·51	0·73	0·84	1·00	0·57	48·6	40·4	10·3	78·7	85·0	20·6
b)	1·63	0·98	0·57	1·46	1·08	0·46	1·55	1·19	0·46	1·25	1·04	0·60	87·7	69·0	40·0	68·0	49·5	28·8

Regional Ventilation and Perfusion in Patients in Group I.

Patient	Ventilation Index						Perfusion Index						Dynamic Distribution Index					
	R.U.	R.M.	R,L.	L.U.	L.M.	L.L.	R.U.	R.M.	R.L.	L.U.	L.M.	L.L.	R.U.	R.M.	R.L.	L.U.	L.M.	L.L.
J.W. a)	2·20	0·70	0·38	1·71	0·82	0·45	1·31	0·77	0·73	1·54	1·00	0·75	34·0	21·6	17·7	63·8	42·0	26.7
b)	2.28	0·90	0·29	2·03	1·19	0·79	2·15	1·09	0·72	1·59	0·95	0·69	65.4	36·5	19·3	96·0	51·6	23·5
W.P. a)	1·26	1.10	0·42	1·26	1·40	0·34	0·81	1·23	0·91	0·88	1·16	0·83	65·8	47·2	12·8	50·0	21·4	14·5
b)	1.20	1.21	0·57	1·29	1·10	0·50	1·87	1·15	0·48	1·26	0·78	0·59	118	118	29·4	116	30·8	14·7
R.P.	0·50	1·28	1·08	0·48	1·21	1.18	0·49	0·97	1·58	0·25	0·95	1·42	20·2	94·5	82·7	16·9	136	112
P.J.	0·86	1.10	0·60	0·97	1·37	0·71	0·52	0·76	0·74	1·79	1·31	0·96	38·2	105	36·6	139	115	28·8
H.K.	0·81	1·36	1·08	0·66	0·81	1·04	0·54	0·87	1·12	1·23	0·79	1·34	42·0	43·7	47.4	47·4	29·2	31·3
E.Sh.a)	0·63	0·76	0·77	0·69	1·80	0·83	1·00	0·82	0·59	0·95	1·33	0·67	62·5	46.5	18·0	50·0	112	16·4
b)	1·03	1·25	0·93	0·79	0·85	0·75	0·81	1·39	1·19	0·52	0·92	0·91	63·7	58·5	28·6	25·9	71·0	33·8
J.S.	0·55	1.29	1·32	0·38	0·95	1·40	0·97	0·95	1·52	0.21	0·56	1·36	31·4	60·2	146	28·1	37·6	97.0
C.Mah	1.95	1·21	0·47	1·77	0·55	0·35	1·53	1·83	1.18	0·70	0·42	0·52	89·0	28·0	18·6	33·8	16.7	15.8
N.H.	1·02	0·69	0·69	1·03	1.15	0·55	1·48	0·74	0·49	1.09	1·51	0·31	24·2	20·0	19·4	47·0	60·5	22.8

Regional Ventilation and Perfusion in Patients in Group II.

Patient	Ventilation Index						Perfusion Index						Dynamic Distribution Index					
	R.U.	R.M.	R.L.	L.U.	L.M.	L.L.	R.U.	R.M.	R.L.	L.U.	L.M.	L.L.	R.U.	R.M.	R.L.	L.U.	L.M.	L.L.
E.N.	1·28	0·85	0·84	1·69	0·96	0·67	1·01	0·93	0·67	1·29	1·13	0·99	60·0	46·2	20·8	53·2	70·3	23·6
L.M.	1·05	0·80	0·57	1·28	1·18	0·99	0·82	0·89	0·93	1·01	1·18	1·06	47·6	26·7	15·0	73·7	64·0	22·0
E.G.	1·09	0·88	1·00	1·19	0·82	1·04	0·65	1·00	1·22	0·84	0·81	1·44	77·5	59·2	52·2	66·8	39·6	40·4
F.K.	2·10	0·98	1·17	0·88	0·85	0·94	2·54	1·27	1·35	0·72	0·55	0·75	66·0	72·0	94·5	33·7	67·0	71·0
R.T.	1·81	1·07	0·43	1·73	1·58	0·40	1·97	1·09	0·69	1·14	1·51	0·75	95·2	28·1	12·5	95·2	27·0	15·0
E.Sc.	1·10	0·89	0·83	1·00	1·22	0·85	1·00	0·91	0·81	1·03	1·06	1·03	24·4	25·7	24·3	29·8	25·4	26·7
E.Pat.	0·87	0·94	1·30	0·93	0·99	0·97	0·72	0·94	1·43	0·63	1·06	1·12	69·5	66·6	73·6	78·8	81·3	103
F.R.	0·86	1·05	0·97	1·35	0·88	0·98	0·96	1·21	1·07	0·80	0·76	1·28	58·0	49·5	115·0	33·0	32·0	36·0

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